Designing for meaning making in museums

Visitor-constructed trails using mobile digital technologies

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Declaration

I hereby declare that, except where explicit attribution is made, the work presented in this thesis is entirely my own.

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Abstract

This thesis investigates how people make meaning in and from museums, through encounters with artefacts which are mediated by portable digital technologies. It provides evidence that technology can help to manage the amount of information visitors encounter, instead of increasing it, through activities which structure the use of technology. One such activity — visitor-constructed trails through museums — is studied in depth, with attention to how (and to what extent) the activity is structured, the contexts in which it takes place, and how various tools and resources mediate and support the activity. Three studies engage different types of visitors in trail construction, using mobile phones and portable digital audio player/recorders — technologies already commonly carried by visitors — in museums of art, science and history. Trails are shown to support meaning making by providing a curatorial scaffolding for visitors to re-contextualise artefacts, through interpretations which are links between visitors' and artefacts' contexts, and are generally narrative in form. Technology is shown to help visitors make connections with artefacts through a two-way contextualisation, and by working in concert with other tools and resources. Meaning making is analysed using a conceptual model for the design and analysis of trails, which is grounded in a constructionist epistemology, a theoretical perspective on museum meaning making, and a methodology derived from activity theory.

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Chapter 1
Introduction

This thesis aims to explore how people make meaning in and from museums, as mediated by portable digital technologies. It investigates visitors' experience of museums through encounters with artefacts which are mediated by tools, focusing on activities which structure the use of technologies. One such activity — visitor-constructed trails through museums — is studied in depth, with attention to how (and to what extent) trail construction activity is structured, the context(s) in which the activity takes place, and how various tools and resources mediate the activity. Visitor meaning making is analysed by looking at the processes by which visitors engage with artefacts and mediating technologies, and not by evaluating specific learning outcomes. This in turn leads to the development of a conceptual model for design and analysis of technology-mediated museum trails, and of the relevant theory around visitor meaning making and technological mediation.

Museums are broadly viewed as places of informal learning, and most people visit museums expecting to learn something (Moussouri, 2002; Ellenbogen, 2002; Falk and Dierking 2000; Falk et al, 1998; Moussouri, 1997; Macdonald, 1993). Some museums and researchers attempt to quantify and evaluate discrete 'learning outcomes' such as specific facts or knowledge gained by visitors while at a museum. But as discussed in Chapter 5, my focus is not on discrete outcomes but on the processes by which visitors make meanings in relation to artefacts. According to Hooper-Greenhill (1999a), 'The process of meaning-making is the process of making sense of experience, of explaining or interpreting the world to ourselves and others. In museums, meaning is constructed from objects, and from the sites themselves' (Hooper-Greenhill 1999a:12). Artefact-centred learning is a central ethos in most museums, but constructing meanings from artefacts is limited without interpretive information, according to Parry (2007:67). In addition, museum artefacts are generally encountered in

the context of other artefacts, and so cannot be considered in isolation (vom Lehn et al, 2005). Trails provide one way of linking individual artefacts in a narrative or thematic structure.

This thesis investigates the concept of visitor-constructed trails across different topic areas, museum and visitor types. Three studies take place in museums of art, history and science; with adults on casual museum visits, primary school students on formal school visits, and secondary students in a structured visit outside of school. Each museum and visitor type is treated separately in each study, but findings regarding context, technological mediation and the structure of activities inform the iterative design and analysis of trail construction activity in each study. Each study also informs the iterative development of a conceptual model for the design and analysis of trail construction activities.

The technologies of particular focus are mobile phones and digital audio player/recorders. This thesis does not assume that digital technologies should take the place of existing non-digital museum tools and resources such as sketchbooks; rather it is aimed at understanding and structuring the use of portable digital devices which are now commonly carried by many museum visitors.

1.1 Motivation

After nearly 15 years of designing technology-enhanced museum exhibits, my work has always been informed by the practicalities of fitting curatorial aims into physical and virtual spaces, and by what has worked in the past based on experience, intuition and observation. As Senior Software Designer for Exhibitions at the American Museum of Natural History, I approached my job in what Thomas (1998b:16) calls the 'museum as media workshop.' What research was conducted with visitors was often after the design and installation of exhibits, and design was often not grounded in either theory or practical research on visitor meaning making. This thesis is therefore motivated by my desire to gain a foundation of educational research to inform the design process. In my experience, museums are a good place to experiment with and research new technologies, as places with both formal teaching sessions and informal, informational spaces; they are filled with authentic artefacts, yet in exhibition spaces in which authenticity is artificially constructed. As settings for research, museum galleries and activities can be controlled to a certain degree, while preserving the messy and unpredictable actions and interactions of visitors of all ages. Visitors spend an average of 15 minutes at computers, as against 15 seconds at other exhibits, according to Mintz (1998:21). However,

according to Morrissey and Worts (1998) studies of technology in museums have tended to focus on the interactions between visitors and the technology itself, not on the relationship between visitor and museum, and how technology can mediate that relationship.

When I began working in museums in 1996, less than a third of the US population owned a mobile phone, and portable media took the form of compact discs. By 2009, nearly 90 percent of the population owned mobile phones, and 40 percent owned portable digital media players such as iPods (*World Almanac and Book of Facts*, 2001; Cellular News, 2009a; Arbitron, 2010). In the UK, mobile phone ownership has surpassed 100 percent, as most people own more than one (Cellular News, 2009b). Due to ever-increasing processor speeds, a 2009 iPhone 3GS, for example, is six times faster than the computers I used in exhibits in 1996. Yet both the computers then, and mobile phones now, were and are used by museums primarily for one-way delivery of curatorial information to visitors, who are generally trying to contain, not expand, the amount of information they take in (Fisher, 2005). As discussed in Chapter 2, digital technologies in museums can help to re-contextualise artefacts (Mintz 1998:25), prompt visitors to look more closely at artefacts (Reynolds and Speight, 2008), convey scientific comparisons (Robinson 1998:50) or complex abstractions (Dierking and Falk 1998:60). Yet in practice, digital technologies are often less interactive than traditional educational activities in museums (Thomas, 1998b:13). This thesis is therefore motivated by a desire to investigate ways to utilise digital technologies for more than information delivery, through structured activities undertaken by visitors. Trails offer one such activity, and are described next.

1.2 Overview of museum trails

Museums have increasingly made use of the World Wide Web during the past two decades, for example to put information about their artefact collections online. Like museums' physical spaces, such databases can be categorised as semi-structured information spaces, and like many museum galleries, virtual spaces frequently offer little to guide a user in navigating through them (Peterson and Levene, 2003). If, as Falk and Dierking (2000) state, meaning is made in the connections between artefacts and visitors' knowledge and experience, how might these connections be structured or made explicit? Technology provides Web navigation with an advantage over meaning making in physical spaces, by providing structured searches and a recorded 'history' of pages visited. But this digital support is not semantic — it offers no support with regard to meaning in the links referred to by Falk and Dierking. The technologies hold great potential, but perhaps not without some structure for their use.

Peterson and Levene (2003) propose that capturing a trail of the places someone has visited — whether real or virtual — can enable what they call 'navigational learning.' They describe a process consisting of 'enacting' or creating trails, then editing, sharing, discussing, and refining or extending them. Portable and embedded digital technologies, they contend, can now provide an analogous experience to Web browsing, with conventions such as bookmarking and keeping a historical record now possible in physical spaces such as museums. While museum-created trails for visitors have a history dating to the 19th century (McClellan, 2003b), and research has been conducted into trails created by educators and curators (e.g. Reynolds and Speight, 2008; Beazley, 2007), the activity of visitor-constructed trails using mobile technologies has not previously been investigated.

Following from this, the specific research questions addressed in this thesis, as detailed in Chapter 5, are as follows:

1. (How) can visitor-constructed trails support meaning making in museums?
2. How do portable digital technologies mediate and support trail construction?
3. What is an appropriate model for the design and analysis of technology-mediated museum trails?

1.3 Overview of studies

This thesis describes the detailed findings from three successive studies in engaging museum visitors to capture and construct trails in museums. A literature review directly follows, divided into two converging chapters: The following chapter reviews the literature on museums and technology. In it, a working definition of museums is developed, and the role of technology in museum meaning making is reviewed, with emphasis on portable digital technologies. Chapter 3 introduces trails as a narrative-centred mental model, and reviews the history of trails in theory and practice, again emphasising the role of portable digital technologies.

A conceptual model for designing and analysing visitor-constructed trails is then developed in Chapter 4, grounded in a constructionist epistemology, situated theoretically in Falk and Dierking's (2000) Contextual Model of Learning in museums, and methodologically in activity theory, which has been proposed as a means of studying technology-mediated activity in context. Chapter 5 presents the research design, detailing the research questions and the methodology for investigating them.

Chapter 6 describes the first study exploring the informal construction of trails by adult visitors to various museums, using portable audio recorders as a mediating technology; the trails are described in detail and analysed using tools adapted from the Contextual Model and activity theory, in order to inform the research questions and iterate the conceptual model. A portion of one of the trails in the first study is shown in Figure 1.1

Figure 1.1 Portion of trail of 'Rachel and Adam' at Tate Modern, from the first study, described in Chapter 6.

The iterated conceptual model informs the next study, detailed in Chapter 7, involving primary school students constructing trails in a botanic garden, using multimedia mobile phones with purpose-built 'mobile learning' software. A photo from the study is shown in Figure 1.2.

Figure 1.2 Two primary school students during the second study at Kew Gardens, described in Chapter 7.

The conceptual model is again refined, then utilised in the final, more focused study, described in Chapter 8, involving teenage visitors constructing an audio trail at a history museum. In terms of technology, the final study goes back to simple audio recording in order to test the broader applicability of the conceptual model, and to focus on the trails concept and how it structures the activity. Finally, conclusions are drawn from the studies, the conceptual model is analysed and further refined, and the findings and implications are described in Chapter 9.

1.4 Definition of terminology

Museums are defined in this thesis as 'semi-formal' places of learning which collect, display and interpret artefacts of some sort, for educational purposes. The term 'semi-formal' comes from Kahr-Højland (2007) who uses it to identify institutions which are not schools but are oriented explicitly toward learning; this is distinct from the broader and more widely used term 'informal learning' which can include most any location outside schools. This thesis focuses on collections-based museums, as distinct from 'science centres' which utilise interactive exhibits to illustrate scientific concepts. However, I include in my definition zoos and botanic gardens, which collect, preserve, display and interpret living things for explicitly educational purposes. This distinction is detailed further in the next chapter.

As discussed, this thesis does not attempt to evaluate visitor learning outcomes, but focuses on the processes by which visitors make meanings. 'Meaning making' is a term used by Falk and Dierking (2000) and in activity theory (e.g., Kaptelinin and Nardi, 2006; Wertsch, 2002) to describe the fundamental motivation of people to interact with the world. In a constructionist epistemology, meanings do not exist objectively in the world to be discovered, but are actively created in human engagement and interaction (Crotty, 2003). Falk and Dierking situate this in evolutionary terms as the way people learn about and from the environment, and regard artefacts in museums as facilitating the construction of meanings about, and within, cultures. Thus, meaning making can be said to occur at a lower level than learning, while simultaneously relating to broader cultural and biological motives; learning, according to Falk and Dierking, is a long-term process which extends well before and after a single museum visit, and this thesis focuses specifically on in-museum meaning making. Activity theory interprets meaning making methodologically, providing a set of concepts for studying meaning making processes — for example, concepts of internalisation and externalisation, tool mediation, and a hierarchical set of motives, goals, activities, actions and operations (Leont'ev, 1978). In this thesis, meaning making is defined as the bridging of visitors' and artefacts' contexts, mediated by tools, as detailed in Chapter 4.

Activities are defined in this thesis, following Kaptelinin and Nardi (2006), as purposeful interactions of subjects with the world, resulting in mutual transformations of subject and object. Activities are the basic unit of analysis in activity theory, and are generally mediated by the use of tools, either physical or conceptual. In this thesis, activities are situated in specific contexts — personal, social and physical — for the purpose of meaning making. The activities are not viewed as arising within contexts, but are designed by the visitors themselves, usually in collaboration with teachers, museum staff, technologists, and/or other visitors. This design process takes place in the museum, and the product is a trail. The focus, therefore, is on the **construction process in context**, and how digital tools mediate that process. Activities are detailed further in Chapter 4.

Trails are defined in this thesis as paths deliberately constructed by museum visitors, linking a series of encounters with individual artefacts, comprised of descriptions and interpretations of the artefacts, which are recorded using portable digital devices. As discussed in Chapter 7, a trail takes the form of digital data, and is thus a re-contextualisation of artefacts from a physical to a virtual context; the topic or theme of the trail acts as a shared social context for the artefacts. This definition of trails differs from that of Peterson and Levene (2003), who regard trails as an emergent phenomenon, arising from visitors' navigation which may be undirected; they regarded visitors' role in trail construction as comparatively passive, with a portable 'experience recorder' automatically

constructing a trail of visitors' locations. In their conceptualisation, the visitor must edit the trail after the visit in order to shape it into a product to be shared or re-used. As discussed in Chapter 3, automatic trail recording technology has been developed by computer scientists to facilitate adaptive content delivery based on visited locations. Yet, as discussed previously, my motivation was not to utilise portable digital technologies for information delivery, but for active construction by visitors. Thus, my definition of trails is grounded in constructionist epistemology, which is discussed in Chapter 4. Trails are discussed in detail in Chapter 3.

Mediation is defined as the way in which tools and resources influence visitors' activity, either by helping or hindering. The specific technologies investigated in this thesis are mobile phones and handheld digital audio recorders. Both are studied in relation to other tools and resources utilised in the trail construction activity, including paper-based tools and museum interpretive resources. Not least, the people involved — visitors, museum personnel, technologists and others — are regarded as mediators. This thesis uses the term 'portable digital technologies,' to distinguish them from mobile phones specifically, and from the field of 'mobile learning' which is discussed in Chapter 4.

1.5 Contributions of this thesis

1. This is the first study on visitor-constructed, technology-mediated trails, validating such trails as an activity for visitor meaning making from artefacts, across different museum and visitor types. It provides evidence that trails can support meaning making among different visitor and museum types by providing a curatorial scaffolding for visitors' re-contextualisation of artefacts.

2. This thesis adds to the trails literature which is focused mainly on technological development and adaptive content delivery, as described in Chapter 3, with research which is pedagogically grounded.

3. This thesis contributes to a dearth of museum research grounded in constructionism, as detailed in Chapter 4. Trails are defined in this thesis as visitor-constructed products, and are investigated in relation to meaning making and the goals of the activity. Technological tools are shown not only to mediate visitors' meaning making, but are used explicitly for trail construction.

4. This thesis contributes to museum research grounded, on the one hand, in Falk and Dierking's (2000) Contexual Model, and on the other, in activity theory, showing that the Contextual Model can

provide a theoretical grounding for a methodology derived from activity theory, as detailed in Chapter 4.

5. This thesis further develops the concept of 'activity contexts' of visitors and artefacts, and the mediation (and multiple mediation) thereof; this concept was originally proposed by Pierroux, et al (2007) and further developed theoretically by Kaptelinin (2008). This concept had not previously been investigated in an empirical study. Specifically, this thesis provides evidence that portable digital technologies can help bridge the contexts of visitors and artefacts through a two-way contextualisation, which may also be mediated by other tools and resources.

6. This thesis informs technology and interaction design research by focusing on the design and analysis of mediated, contextualised activities centred on meaning making, not on the technologies themselves. Specifically, the conceptual model developed in this thesis provides a means of designing and analysing trail-based activities, with rich descriptions of visitors' and artefacts' contexts, and goal-oriented activity leading to a concrete product and mediated by technological tools and other resources.

1.6 Summary

This chapter provided an overview of the research in this thesis, describing the aim to explore meaning making in museums, as mediated by portable digital technologies, through the design and analysis of trail construction activities undertaken by different types of visitors in different types of museums. Particular attention is paid to the personal, social and physical contexts of visitors and artefacts, the bridging of these contexts, and the linking of artefact interpretations through re-contextualisation. I described my motivation to add pedagogical grounding to technology design in museums, and to harness powerful, portable digital devices for more than simple information delivery. Trail construction was described as one activity to structure the use of devices visitors are likely to be carrying already, by linking interpretations of individual artefacts in a shared social and virtual context. This is investigated in the three studies in this thesis, after a literature review in the following two chapters, the development of a conceptual model in Chapter 4, and a description of the research design in Chapter 5.

Chapter 2
Literature review of museums and technology

This chapter reviews the literature on museums and technology, in order to identify areas in which to focus the investigation, and to lay a foundation for the development of a conceptual model for the design and analysis of trail construction activities. First, a working definition of museums is constructed for use in this thesis, which is broad enough to encompass a range of 'semi-formal' learning sites, to use the term of Kahr-Højland (2007), but restricted to institutions which collect, display and interpret artefacts of some sort. Since the educational functions of museums are intertwined with their broader cultural roles, the latter are reviewed first, followed by museums' educational role in greater detail, with emphasis on the role of artefacts in meaning making. Next, museums' use of digital technologies is reviewed, with emphasis given to portable digital technologies. This will lead into the following chapter, which introduces the trails concept and technological support for it.

2.1 Definition of museums

Although museums today are broadly viewed as educational institutions, it is important to situate them in their larger political, economic and cultural context. First I must provide a working definition of 'museum' to be used in this thesis. The International Council of Museums (ICOM) defines a museum as 'a non-profit making permanent institution in the service of society and of its development, open to the public, which acquires, conserves, researches, communicates and exhibits, for purposes of study, education and enjoyment, the tangible and intangible evidence of people and their environment' (ICOM web site, accessed 18 Jan 2008).

Unpacking this definition exposes some embedded assumptions. A 'permanent institution' implies a physical place, and most museums are housed in a single building or complex. Related to this is that people generally travel *to* museums — though in an Internet-connected world this need not mean physically; nonetheless, a museum usually has a physical presence somewhere in the real world. This presence is usually physically imposing and/or distinctive, for as the ICOM definition continues, a museum is 'in the service of society.' They are intended to serve 'the public' (the next part of the definition), and they succeed in evoking public trust as sources of information, in their physical manifestations more so than their online ones, according to Griffiths and King (2008). However, just *which* public or publics is a crucial question, and despite external pressure and increased educational offerings, the demographic profile of casual museum visitors has changed little since public museums were first established, according to McClellan (2003b). This is discussed further in the next section.

The definition of museums used in this thesis includes museums, galleries, archives, botanic gardens, zoos, and historic sites. From a visitor's perspective, all of these are generally regarded as places of informal learning; zoos and botanic gardens, as 'bioexhibits,' are not far removed from the stuffed animals and plastic plants displayed in natural history museums (Robinson, 1998:38), and the line is blurring further as botanic gardens introduce more scientific displays, and museums incorporate live animals into exhibits.

Such a definition could open up a broader spectrum of possible education/enjoyment sites such as entire cities or wilderness areas. A distinction in the ICOM definition, however, is that the institution explicitly communicates educational information, for example with explanatory labels or some other form of what Samis (2007) calls 'interpretive scaffolding.' Such interpretation provides a simple framework upon which educational activities and interventions can be introduced. Kahr-Højland (2007) terms museums 'semi-formal learning settings,' as institutions with explicit educational missions but which do not rely on a set curriculum or on testing visitors' knowledge. This situates museums between formal learning institutions such as schools, colleges, and universities, and broader places of 'informal learning' which do not have an explicit educational mission.

Kahr-Højland (2007) also makes a distinction between museums based on collections of artefacts, and science centres which aim to convey ideas through hands-on interactive exhibits. Both can be considered semi-formal learning settings in her definition, but while she focuses on science centres in her research involving portable digital technologies, I restrict my investigation to collections-based museums. This is to narrow the scope of investigation, focusing on the links between artefacts. While a conceptual trail could be traced through a series of interactive exhibits in a science centre,

collections-based museums provide a wider scope for investigation in the form of physical artefacts which are subject to multiple interpretations, instead of narrowly focused interactive exhibits. I do, however, review and draw from some of the research carried out in science centres, where relevant to this thesis.

This thesis is intended to analyse technology-mediated trail construction activity across different types of museums and visitors. Therefore I do not restrict the investigation to a particular museum or type of museum, nor to a particular visitor type; only to museums with collections of artefacts. This is intended to facilitate some generalisations across various museum types and visitor groups, which are detailed in the final chapter.

2.2 Museums' broader cultural context

With a working definition of museums, I now locate museums in their broader cultural and historical contexts. There is evidence of museums in Babylon in the first millennium B.C., and of art galleries in ancient Athens (Mintz, 1998:30). Zoos and botanic gardens are at least 4000 years old, with evidence from Imperial China and pharoanic Egypt (Robinson, 1998:38). Through their collections and their generally imposing presence, museums tend to convey power, authority and the dominant values in a culture (Hein, 1998:157). Art museums in particular wield such power that they are broadly accepted as providing the guiding narratives of the art world, to the extent that 'art is what is shown in museums' (McClellan, 2003a:xiii).

From an anthropological perspective, a culture is defined by shared knowledge, as 'a system of inherited conceptions expressed in symbolic forms by means of which people communicate, perpetuate, and develop their knowledge about and attitudes toward life' (Geertz 1973:89). In this definition both artefacts and language are cultural products. Communication — the sharing of knowledge — is related to ritual, and reality is reproduced, maintained, or transformed in rituals. Thus culture is, in effect, produced through communication. Museum-going, in an anthropological view, is one such ritual.

For example, in art museums, the predominant experience of artefacts has been in silence and isolation, lest other visitors' voices drown out 'the silent voice of the master,' or lest interpretive materials such as labels distract from the authentic masterpiece itself (McClellan, 2003b:20-26).

Other observable ritual behaviours include hushed dialogue in art galleries (Gottlieb et al, 2004); family conversations and interactions in science museums (Allen, 2002); and the phenomenon of 'shadowing' — the tendency of visitors to look at artefacts that other visitors are looking at, or to otherwise emulate their behaviour. Museums thus have not only a social but a socialising function, as a place where people 'learn the skills of public interaction' (Bradburne, 2001), acting as a 'space of emulation' (Bennett, 1995:98). Bourdieu (1984) argued, however, that the 'cultural capital' required for 'taste' and connoisseurship in art was only attainable *outside* the museum, through superior education and upbringing. Indeed, even today casual museum visitors tend to be people with high levels of both income and education, and family encouragement has been found to be more effective than school visits in developing a lasting interest in art (McClellan, 2003b:37). However, most analyses of museum visitors fail to include children or schools, which present a much more diverse picture, according to Hooper-Greenhill (2007:85).

Parry (2007) situates the rise of public museums within broader efforts arising during the Renaissance to increasingly structure knowledge, and to give meaning to fragments of the past and present; the emblematic pairing of artefact and text was seen during the Renaissance as an act of eloquence and wisdom, and physical spaces were seen as frameworks for arranging ideas. According to Hunt (2005):

> Labels for individual objects really only came in with the Victorians. The idea being that the uneducated masses could receive some information and instruction about what they were looking at. Ever since then, things have got out of hand as far as object labeling is concerned. We have now got to the stage where some museum visitors spend more time looking at the label than at the object itself. And I wouldn't be at all surprised that the same holds true in some museums where computer terminals are available. (Hunt, 2005:9)

The UK's Department for Culture, Media and Sport equates culture with learning, by viewing museums and related institutions as 'cultural organisations' charged with 'inspiring and supporting a learning society as they reach out to the widest possible range of audiences' (DCMS, 2007), helping 'people learn at every stage of their lives' (DCMS, 2005). The language is strikingly similar to that directed at digital technologies by the government. Indeed, technologies are viewed as important to museums' educational role by broadening access to collections, facilitating engagement, and empowering audiences (Earle, 2007).

Simultaneously, museums are under commercial pressure to compete in and with the 'leisure industry,' though attendance at art museums generally surpasses that of sporting events, for example (McClellan, 2003b:33). To compete against theme parks, malls and sporting events, there has been a tendency to add interactivity or technology — however gratuitous — or to mask serious subjects in the guise of popular culture, in order to make their offering more 'fun,' according to Bradburne (2001).

From the preceding discussion, it can be seen that making meanings in museums is closely tied to public perceptions of their cultural authority, and the social practices they inculcate. They are places of entertainment as well as education, and like museums, digital technologies also have entertainment functions as well as political implications with regard to meaning making. An activity such as trail construction, therefore must thus account for these broader cultural and political arenas.

2.3 Museums' educational roles

Having situated museums in their broader cultural and political contexts, I next focus more specifically on their educational roles, in order to inform the subsequent discussion of artefact-centred meaning making.

Public museums have been concerned with educating the public from their inception, with the opening of the Ashmolean Museum in Oxford in 1683 (Hein, 1998). During the Victorian era, museums adopted the rhetoric of aspiration in aiming to educate the lower classes about higher art and science, not only in Britain but throughout Europe, as the Industrial Revolution increased urban populations and widened the class divide (McClellan, 2003b:7-16). Docents and educational programmes began about a century ago (Ibid., 19). Today, museums' missions are generally stated as providing education through the exhibition and interpretation of their collections, and thus only secondarily in educational programs (McClellan, 2003a:xvi). But a focus on schools in their explicit education provision has resulted in museums being viewed primarily in terms of how they contribute to formal education (Hooper-Greenhill, 2007:19).

Most people go to museums expecting to learn something (Moussouri, 2002; Ellenbogen, 2002; Falk and Dierking 2000; Falk et al, 1998; Moussouri, 1997; Macdonald, 1993). Visitors usually do not have a predetermined idea of just what they are going to do or learn unless they know a lot about the subject; thus they willingly allow the museum to structure their visit to a certain extent (Smith and

Tinio, 2008). Museums do not generally test visitors about what they have learned, though according to Hooper-Greenhill (2007:24) visitors themselves do make judgements about how far they have moved forward in their understanding and abilities. Eighty-seven percent of adult visitors claim to have learned something new from an individual museum visit (Griffiths and King, 2008).

Much museum literature (e.g. Hooper-Greenhill, 1999a; Thomas and Mintz 1998) does not distinguish between science, art and history museums. However, as Pierroux, et al (2007) point out, different types of museums adopt different epistemological positions depending on their type: for example, history museums relate knowledge to cultural identity, science museums view it in terms of learning abstract scientific concepts, and art museums link meaning making to direct aesthetic experience. In addition, history and science museums are more likely to use facsimiles and reproductions in the service of conveying ideas, whereas art museums retain a devotion to the authentic at the expense of telling a complete story (Levenson, 1998:98). Thus although this thesis examines trails across different museums and visitor types, the particularities of different audiences and museum types are distinguished in the analysis of each study.

2.3.1 Social aspects of meaning making in museums

Most museum visitors are seeking a social as well as educational experience (Hood 1983:50), with 61 percent of visitors going to museums with others (Griffiths and King, 2008); spending time with friends or family is one of the main motivations for visiting (MacDonald, 2002; Pekarik et al, 1999). Interfering with social interaction, for example in the way that exhibits are designed, has been shown to impact both meaning making and enjoyment (Allen and Gutwill, 2004). There is considerable evidence that museum visitors are strongly influenced by their own social group (Ellenbogen, 2002; Crowley and Callanan, 1998; Borun et al, 1997; Schaubel et al, 1996). For example, one visitor in a group often serves as a 'reader' of interpretive materials (McManus 1989:92). There is also evidence for the influence of those outside the social group such as explainers, guides, demonstrators, performers — or indeed other visitors (Astor-Jack et al, 2007; Crowley and Callanan, 1998; Falk et al, 1998; Wolins et al, 1992; Koran et al, 1988).

Interpretation is defined as a negotiation in the form of dialogue — either an internal dialogue (Hooper-Greenhill, 1999a), a tacit dialogue between visitor and curator (Stainton, 2002), a dialogue between individual and environment (Falk and Dierking, 2000:136; Borysewicz 1998:113), or external conversations between people collected around an artefact or connected by technology (Van

Moer, 2006; Wenger, 1998). McManus (1987) sees a museum visit itself as a long conversation, which continues after visitors leave the museum.

Allen (2002) recorded conversations between visitors to a hands-on science centre; Allen's own comments — giving contextual and activity-related information about the visitors under study — were also recorded and analysed alongside the visitors'. She observed that visitors' conversations veered between knowledge, the situation, actions to be taken, and descriptive language. Allen concluded, 'Hearing or reading visitors' complete conversations is a vivid experience that brings one right into the arena where real museum learning occurs.... It is much easier to understand visitors' personal or social contexts when studying a half-hour of their conversation than the few minutes typical of a single-element interaction' (Allen 2002: 298-9). Most of the time in Allen's study, visitors talked about the exhibit in front of them; only five percent made any conceptual connections between exhibits. Griffin (2004) recorded students on a school visit to a science museum, and detected 'learning-related' talk 80 percent of the time. However, in contrast to Allen (2002), such discussions took place mostly between, not at, exhibits. There would thus appear to be scope for a structure such as a trail, to help visitors make links between exhibits or artefacts in both science and art museums.

Gottlieb, et al (2004) also saw the importance of conversations first hand. For example a pair of teenage boys in the study wrote mainly one-word answers on a questionnaire; but observed on video in the gallery, they could be seen talking animatedly about every artwork. The authors, drawing mainly from Vygotsky (1978), look more broadly than conversations, to include interest/disinterest, time spent at each work, visual interactions, and gesticulation, in addition to aesthetic judgements, and mastery and appropriation of concepts. 'Visitors learn how to interpret and give expression to their aesthetic experience by using both cognitive and physical tools for learning' (Gottlieb et al, 2004). For the authors, activities are the main unit of analysis: the activity of studying art in a gallery and having conversations about it. The authors locate moments of meaning making in the asymmetrical knowledge exchange between more experienced and less experienced visitors in the gallery. This exchange is described by Vygotsky (1978) as 'scaffolding' by the more expert peer, and 'appropriation' by the less expert peer. This thesis is also grounded methodologically in activity theory as developed by Vygotsky and others; this is discussed in detail in Chapter 4.

As noted previously, a distinction must be made between museums based around collections of artefacts, and 'science centres' which employ interactive exhibits to convey scientific concepts. Since

this thesis focuses on collections-based museums, the centrality of the artefact in museum meaning making receives closer attention in the following section.

2.3.2 The role of artefacts in museum meaning making

As stated previously, most museums collect and display artefacts for explicitly stated educational purposes; museums are, in Parry's (2007:58) words, 'the material world in a box.' According to Morrissey and Worts (1998):

> As individuals we collect objects that connect us to other people, places, and times. As institutions, museums collect objects for the same reasons, as they try to document collective standards of quality and provide insights into cultural trends (Morrissey and Worts 1998:147).

The care of collections of artefacts in museums is the responsibility of curators, defined as keepers or guardians, stemming from the Latin root *curare*, meaning 'to care for.' (Webster's Revised Unabridged Dictionary, 1913). Curators generally have some knowledge in the subject matter of the collection they care for, although according to McLean (2007), they may not necessarily be experts; regardless, they are widely regarded as authorities in the subject. The work of curators involves investigations into the historical provenance of artefacts, and selecting artefacts from the collection to display in exhibitions, generally as a means of telling stories (Halloran et al, 2005). The term 'curator' has become increasingly used more broadly in popular culture to denote any person (or even computer program) knowledgable about a topic, who selects, edits and presents a subset of data to an interested audience (Schlatter, 2010; Williams, 2009).

According to Halloran, et al (2005):

> A story is not so much about the artefact itself, rather about how it came to be here and what is its relationship to other objects. There are many stories to be told and different perspectives from which they can be told, and these stories often overlap with others. We have further come to understand that there is seldom a 'true story,' as curators describe parts of their research to be almost like 'detective work.' Thus information exists in several layers.

Artefact-centred meaning making is a central ethos in most museum education provision. 'In museums, meaning is constructed from objects, and from the sites themselves,' according to Hooper-Greenhill (1999a:12), adding that 'object' could also refer to an object of study in a hermeneutic sense. The term 'artefact' is used instead of 'object' in this thesis to denote the material things that museums collect, display and interpret. The term 'artefact' also carries implicit assumptions, in its case deriving from its definition as a thing reflecting human will, as in the word 'artificial.' In the context of zoos and botanic gardens this definition holds, for although they display natural things (animals and plants), those things have been selected by humans (in both the sense of being chosen, and in terms of genetic selection in the case of bred species), collected, displayed and interpreted in a similar way to human-created artefacts in museums. Thus, of the two terms, 'artefact' is less ambiguous for describing material things, as will become important when the conceptual model is developed in Chapter 4.

In the field of Museum Studies, the process of knowledge construction has generally been seen as a one-to-one relationship between individual visitors and individual artefacts, and much of museum education consists of training visitors in how to look closely at artefacts in particular ways (McClellan, 2003b:36). Artefacts are seen to evoke memories and prior knowledge, and Hooper-Greenhill (1999a) sees the active mental construction of knowledge as a dialogue between observation and deduction, whole and part, past and present. Artefacts, subject to different meanings by visitors and curators, are termed 'boundary objects' by Star and Griesemer (1989), as objects robust enough to maintain a common identity across communities, yet plastic enough to be interpreted in different ways.

Meaning making through interpretation of artefacts

Artefact-based approaches to meaning making echo Dewey's (1910) notion of 'object lessons' in classrooms. But to Dewey, it was not enough merely to present artefacts; they need interpretation (Dewey 1910:141). Since the museum is an artificial construction, the artefacts in its collections mean little without the knowledge and 'contextual material' which give meaning to them (Parry, 2007:67); indeed the collection of information about artefacts has been as important to museums' mission as the artefacts themselves (ibid., 76). According to Price (2002), 'The role of museums is no longer limited to the conservation of objects: they also have to share and continuously reinterpret them.'

De Vries, et al (2008) define interpretation as 'the key process by which humans make meaning out of external representations. Interpretation depends on cultural conventions and on person, task and situation characteristics.' Specifically with regard to museums, Hooper-Greenhill (2007:2) sees interpretation as a social process involving the attribution of meaning; this constitutes the 'curriculum' of the museum.

Museums generally provide interpretation in various forms, and visitors require varying degrees of 'interpretive scaffolding,' according to Samis (2007), though not necessarily correlated with their familiarity of the subject matter. He found that visitors who were familiar with a particular artist tended to use more interpretation than those not familiar: 'Use of a greater number of interpretive resources correlates directly with enhanced meaning-making, greater appreciation of the artist, the exhibition, the museum experience.'

Abu-Shumays and Leinhardt (2002) developed an 'object-based activity model' consisting of identification (of the type, source and context of an artefact), and interpretation (including the visitor's direct response as well as informed 'transformational communication' such as museum docents provide). The authors believe that such transformational communication can be learned by visitors, even if they lack a deep knowledge about the artefacts. At any rate, as McLean (2007) observes, few museum practitioners are themselves 'expert' scholars or scientists, most being simply well-educated citizens with some experience in translating expertise into accessible information and experiences. She therefore envisions future museums as 'physical wikis' in which visitors participate in the creation and care of exhibits.

Visitor-generated interpretations in narrative form can thus consist of linkages between individual artefacts, and between artefacts and visitors' lives. The 'Revisiting Collections' project (Reed, 2006) aimed to engage diverse audiences in interpreting individual artefacts. The project was meant to foster explicit cultural connections — such as to the country an artefact comes from — in order to appeal to new or non-visitors. It was based on the notion that curators seek the 'truth' about artefacts — objective facts — as shown by the categories in the artefact classification databases they use; any other contextual information is deemed 'interpretation.' The project aimed to open up such databases to real or imagined stories about artefacts by members of local communities. However, this project was not linked to physical exhibitions, only online documentation systems.

In museum galleries, as against collections databases, artefacts are generally encountered in proximity to other artefacts, and museums generally display artefacts together in thematic or other types of

groupings. As described above, most approaches to museum meaning making are focused on individual artefacts. Trails, however, are intended to link artefacts together; thus the next section considers connections between artefacts.

The importance of considering artefacts in context

Those who argue for the primacy of the artefact (e.g. MacGregor, 2005) are those who have studied them for years — in a word, curators. For the visiting public however, isolating individual artefacts amid the bare white walls of a gallery decontexualises them (McClellan, 2003b:19). Museum artefacts are generally encountered in the context of other (often similar) artefacts, along with interpretive information and other tools and resources, and so cannot be considered in isolation.

Since museum visits generally last only a few hours, the 'dwell time' at any single exhibit or artefact is usually less than 30 seconds (Beer, 1987; Cone and Kendall, 1978). vom Lehn, et al (2005) found that:

> the context in which visitors see and experience exhibits is not prefigured by the design and arrangement of the artefacts but emerges in and through their action and interaction. Participants see an exhibit in the light of exhibits they have seen before and in anticipation of exhibits they see next. (vom Lehn et al, 2005)

Thus as Samis (2008) puts it:

> The museum is the sum not of the artworks it contains, but the experiences it triggers... interpretation can only be an accumulation and juxtaposition of different experiences, none definitive but each building a case for what is commonly held or individually specific. (Samis, 2008:9)

Some researchers have attempted to tap into visitors' sense of connections by having them create concept maps (Anderson, 1999), mind maps (Leinhardt and Gregg, 2002), or a variation called Personal Meaning Mapping (Falk et al, 1998). The latter approach engages a single visitor in writing his or her interpretations, usually as single words arranged on a paper, which are then linked together with lines. This is done both before and after a museum visit, with for example different coloured pens. As such it does not attempt to provide anything but a cursory measure of visitors' meaning

making over the short term, instead focusing on what visitors themselves value qualitatively; it is usually supplemented with interviews. Trails utilising portable digital technologies, by contrast, could provide richer means for capturing visitors' interpretations, as well as a more lasting and useful record for future meaning making.

Centre Pompidou (Puig et al, 2009; Puig and Sirven, 2007) has gone a step further by creating a tool which enables visitors to combine individual interpretations into a narrative form. But the tool is intended for a narrow use and type of visitor — for film critics and serious *amateurs* to create 'signed readings' of films or film concepts. While visitors' interpretations can be captured using mobile phones, in order to shape the captured audio data into coherent narratives, visitors must construct them on a web site after the visit, and this requires knowledge of time-based editing software.

The next section reviews the roles and relations of technology in museums, focusing on portable digital technologies and their relevance for visitor-constructed trails.

2.4 Museums' use of digital technology

The use of computers in museums dates to the 1960s, when they were first used for collections databases; they later entered the galleries as interpretive tools such as computer kiosks filled with additional information (Parry, 2007). More recently, networked technologies have enhanced museum outreach efforts, making possible for example 'virtual museums' which resemble their host institutions to varying degrees. Portable digital technologies put the virtual world directly into visitors' hands at the place of encounter with artefacts; this mediated encounter is the focal point of analysis in the studies in this thesis. The historical and conceptual relations between digital technologies and museums are discussed next.

2.4.1 Relations between museums and digital technology

Both museums and digital technologies involve a suspension of reality on the visitor's or viewer's part (Thomas 1998b:2) as both involve acts of simulation and display, through the storage, indexing and connecting of data (Parry, 2007:82). While digital technologies make possible 'virtual realities,' museums and zoos are already artificial constructions (Robinson 1998:46). According to Perlin (1998:80), both museums and technologies employ artifice to create a sensation of the real,

immediate or authentic. One means of doing so is through editing (Thomas 1998b:5) which, like curating, is the domain of experts (Parry, 2007:2). The result is often narrative in form (Thomas 1998b:9), and in both museums and media, the line between entertainment and education is blurred (Borysewicz 1998:105). Trails, as investigated in this thesis, act as a site and a means for the re-contextualisation of museum artefacts through visitors' interpretations.

Many museum researchers (e.g. Putnam, 2009; Parry, 2007; Hooper-Greenhill, 1999b) consider the museum itself as a medium, following McLuhan (1964) who stated that media send their own messages which are distinct from the 'content' they carry. Museums are also full of other media themselves, including digital media. According to Parry (2007), such technology is not value-free but was originally designed for the world of work, hence 'desktop' user interfaces and computers are inherently unsuited to museum meaning making (Parry, 2007; Ciolfi and Bannon, 2003).

According to Levenson (1998:93), the image quality of a computer screen is similar to an oil painting viewed under strong light, and sees screens as therefore suitable, at least, for investigating the medium of oils. Mintz (1998:32) however points out that a painting shown on a screen has no texture; any sense of scale is lost; colours are not true; and the resolution is often much lower. Computers themselves, she notes, are ephemeral in comparison with museum artefacts (Ibid., 30). She concludes that 'Information can be conveyed electronically. The enduring experience of art cannot' (Ibid., 32).

What technology can perhaps convey better than museums, however, is multiple perspectives (Morrissey and Worts, 1998:155). A discourse of democratisation has arisen around 'user-generated content' mediated by digital technologies, with the perceived result that the visitor, rather than the museum, becomes a focus for in-gallery meaning making. But whether digital technologies enable visitors to usurp or bypass curatorial authority, as museums fear, is far from certain. Besser predicted in 1997 that when the public had access to digital museum collections at home, they would make their own links and juxtapositions, further eroding curatorial authority. 'A possible result may be an erosion of high culture in general, with the curator's role becoming something akin to that of a film critic' (Besser, 1997). Yet the public has shown no desire to challenge the authority of the museum. Instead, networked digital technologies have *increased* museum attendance, as Anderson (1997) predicted the same year:

> It is probable that technology will not undermine but stimulate the public's desire to have a gallery experience; the virtuality offered by new media may balance and complement, rather

> than erode, the actuality that is to be found in real human relationships and contact with authentic objects in museums. (Anderson, 1997)

In fact, both online and on-site museum visits have increased in the last decade or so: Internet users are 91 percent more likely to visit a museum, and visit 2.6 times more often, than non-users (Griffiths and King, 2008). However, there is little evidence that online visitors are more likely to generate more content than on-site visitors. For example, the Victoria and Albert (V&A) Museum website solicits visitors' memories of their first visit to the physical museum (http://www.vam.ac.uk/collections/periods_styles/features/history/first_visit/index.php). However, after several years it contained only six entries, most of which were by museum staff. This means that either no one is contributing, or that no one on the museum staff is moderating and posting the visitor-generated content. According to Bandelli, et al (2009), a dialogue is possible not just when visitors speak, but when museums listen.

By contrast, the V&A's 'Design your own Arts and Crafts tile' online activity unwittingly created an active online community, as people used the online gallery not only to post their designs but to communicate with each other through the text descriptions of their designs. The site, not intended for communication between visitors, became very popular, linking remotely located participants with shared tastes and interests, and spawning lasting friendships (Durbin, 2006).

Tate Britain has an online activity for website visitors to create their own 'collections.' A small subset of images from the museum's digitised collection is available, from which the visitor chooses six, then name the collection and send a link via email, or print it as a two-sided leaflet which locates the chosen artworks on a floor plan. However, the museum automatically attaches the curatorial label to each chosen artwork, and provides no opportunity for the visitor to edit it or add any personal interpretation. This activity also had not been updated in months for lack of funding, according to Eva (2007).

'Nexhibition' (http://nexhibition.thinkdesign.com/) went a step further with a web-based system for curators, educators or visitors to create their own online 'exhibitions' from a database of images. However, as of June 2007 this was a demonstration only, with no participating museums, and no guidance or motivation for creating exhibitions along particular themes. As of November 2008, the site no longer existed.

Thus, despite the technical ease of soliciting visitor contributions, visitor motivation is a clear challenge for museums, except where there are specific, engaged communities and/or targeted activities, as for example the V&A's tile activity. This thesis explores trail construction as one type of targeted activity.

2.4.2 Roles of digital technologies in museum galleries

As discussed previously, technological tools can mediate visitor meaning making in relation to artefacts, according to Thomas (1998a:viii). This can include helping to re-contextualise artefacts, for example in virtual re-creations of original contexts (Mintz 1998:25), or in explorations of artefacts' design and use (Reynolds and Speight, 2008). Like text labels, technology can prompt visitors to look more closely at artefacts (Ibid.). Technology can also better convey scientific comparisons (Robinson 1998:50) or complex abstractions (Dierking and Falk 1998:60). While technologies must compete in an already sensorally rich environment, when used well, according to Thomas (1998b:15), they should disappear, letting the narrative of artefacts and exhibitions come forward. This view mirrors the way activity theory approaches the design of technology, aiming for users to look 'through the interface' to the task at hand (Bødker, 1991). Activity theory is discussed further in Chapter 4.

However, despite their association with interactivity, digital technologies in museums are often less interactive than traditional museum educational activities, according to Thomas (1998b:13). They have tended to distance visitors from artefacts, rather than augment the artefacts (Ciolfi and Bannon, 2003). Many museums have justified the introduction of computers in galleries as way to give children something to do (Mintz 1998:30). On the other hand, even children's museums have sometimes avoided interactive media, viewing it as a toy that distracts from educational content (Thomas 1998b:11). This is not unfounded, since there is evidence for random button pressing by children when technology is present (Peacock, 2004: 2, in Kahr-Højland, 2007:130). Children are less self-conscious than adults about using media, especially those with large displays, because adults come to museums to enjoy themselves and not to look stupid, according to Mintz (1998:32). Nonetheless, visitors spend an average of 15 minutes at computers, as against 15 seconds at other exhibits (Ibid., 21). Visitors are also more likely to use media early in a visit, being increasingly more selective as they reach cognitive or sensory overload (Sweller et al, 1998; Dierking and Falk 1998:64).

Yet visitors expect to have access to the latest technology in museums, and according to Borysewicz (1998:107), museums have been among the most experimental groups in working with media. While there is a tendency among curators to try to use computers to tell public more than they want or need to know about a topic — treating computers as 'the tip of a multimedia iceberg of archival material' according to Parry (2007:112) — Mintz contends that technology can help visitors experience exhibit more like an expert (Mintz 1998: 27), and that used well, technology can control the amount of information or expand visitors' options (Ibid., 32). This applies particularly to portable technologies, which are discussed in the next section.

2.4.3 Portable digital technologies in museums

Pencil and paper can be seen as a very old portable technology used in museums, and it remains to be seen whether digital devices can match the many benefits of drawing artefacts (Brookes, 1996). However, sketchbooks are regularly carried by only a small subset of visitors, for example students in art and design (Cook et al, 2010). In this thesis I focus on portable digital devices including mobile phones, iPods and audio recorders, for the simple reason that today, far more visitors carry them than carry analog media such as sketchbooks; as discussed in the previous chapter, this thesis seeks to understand and harness portable digital technologies that visitors already carry.

If, as Mintz (1998) claims, technology in museums gains legitimacy through its proximity to authentic artefacts, portable digital technologies could be considered more 'legitimate' through their use directly in the place of encounter between visitor and artefact. Because of their portability, such devices can also act as a bridge between multiple physical contexts, such as between the museum and school or home (Wali, et al, 2008).

Initial implementations of portable digital technologies in museums have tended to treat them as smaller versions of desktop computers, their main benefit perceived to be the ability to deliver information to visitors directly at exhibits. According to a recent survey, most museums think of handheld guides primarily as providing additional or supplementary information to visitors (Tallon, 2009). One of the differences between fixed and portable digital devices, however, is that visitors engage with the latter for a much longer period of time. As such, museums which remain focused on the primacy of the artefact have regarded technologies as distractions from the collections. This attitude is not new; even the glass display case came in for such criticism when it was first introduced (Griffith, 2003:388). The issue of distraction is an issue explored in the studies in this thesis.

Audio guides

Audio guides — typically a pair of headphones connected to a digital audio player — are used by more than half of art museum visitors (Tallon, 2006), and they hold important lessons for the development of trail-based technologies and activities. Audio guides have been consistently shown to alter visitors' experiences. Smith, et al (2004), for example, report that 'visitors who use audio spend more time in front of the works, develop a stronger interest in the artist, and are more likely to report a positive emotional response to the works.' Woodruff, et al (2001) report that 'Visitors strongly prefer audio because it relaxes demands on their visual attention.'

According to Tallon (2008), when audio guides moved from magnetic tape to digital technology, they sacrificed a linear curatorial narrative for visitor choice, since with digital technology, visitors could listen to tracks in any order, instead of a continuous narration instructing them where to go next. The most common reason that visitors choose *not* to use audio guides is that they do not wish to follow a preset route through a museum; even visitors who use audio guides share this impression, because even though most audio guides today are random-access, they typically use a linear numbering system (Science Museum, 2003). Thom-Santelli, et al (2005) found that portable museum guides dictate particular ways of navigating and experiencing a museum, to the exclusion of other ways.

The quality of audio guides varies widely, and while traditionally voiced by curators, museums now have tours narrated by artists and celebrities. In 2005, university students calling themselves 'art mobs' created and disseminated their own downloadable audio guides to the Museum of Modern Art, using collections information from the museum's website. According to Samis (2008),

> The news rippled like shock waves from an earth tremor in the museum world. For the first time (or rather the first time again — as artists have a long-standing tradition of undermining museum authority going back at least as far as Marcel Duchamp), someone had publicly usurped the museum voice from an esteemed, authoritative institution and substituted a set of opinionated, perceptive, and irreverent alternatives. Canonical works were no longer hallowed; in fact, some were actively ridiculed. (Samis, 2008:6)

Thus research from audio guides shows that audio is a powerful mode of meaning making, whether in a linear curatorial narrative, in visitor-controlled navigation, or in guides which disrupt curatorial authority. Audio guides created by visitors themselves — whether as trails or some other form —

have not been previously investigated in an empirical study. By contrast, museums have added additional capabilities to their own portable digital guides as the technology has developed, and aspects of these multimedia guides relevant to trails are reviewed next.

Multimedia guides

When small-screen presentations are intended to mediate visitors' encounters with non-digital artefacts and environments, it is reasonable to assume that a screen-based presentation could itself be considered 'extrinsic cognitive load' to use the terminology of Sweller, et al (1998). Support for this comes from Fisher (2005) who tested multimedia guides on portable 'Personal Digital Assistants' (PDAs) in four different museums: the Royal Institution, @Bristol (a science centre), the Fitzwilliam in Cambridge, and Think Tank science centre in Birmingham. She reported that PDAs added to the surfeit of information already in the museum environment: 'People are as likely to be trying to contain the amount of information they have to take in, as much as they are trying to expand it.' In addition, vom Lehn, et al (2005) describe a 'curious division of labor' when groups of visitors use a single device, for example one visitor reading out information from the screen while the other views the artefact.

Thom-Santelli, et al (2005) designed a multimedia guide intended to be more 'interactive' than an existing paper-based activity, intended to help contextualise ancient artefacts, and to introduce students to both new technology and old artefacts. However, the authors' definition of interactivity is limited to multiple-choice questions on a screen, plus one 'interactive element' for each artefact — an on-screen tower-building activity, a painting activity, or a pre-authored narrative.

Following Mintz (1998:32), Fisher (2005) suggests that portable digital technologies could, instead of adding information, constrain and direct a visit, for example directing a user to look at particular artefacts. PDA-based trails at Dulwich Picture Gallery asked questions which could only be answered by looking at the artefacts (Beazley, 2007). Fisher (2005) highlights PDA functions that give the devices advantages over other media. For example, they help direct visitors to points of interest that might otherwise have been overlooked; this was particularly true at the Royal Institution, which has a richly historic building but few artefacts. PDAs also allow transformations of artefacts not possible or practical with the real thing, according to Fisher: 'By playing with the object on-screen, the visitor comes close to playing with it in real life, which is the way all of us, at base, like to learn' (Fisher, 2005).

Results from PDA trials should not be generalised to all visitors, since most have been targeted at younger audiences. Beazley (2007) found during the use of PDAs at Dulwich Picture Gallery that secondary students initially were engaged primarily by the technology, but it soon became almost second nature to them, and served to focus them on making meanings related to specific aspects of art and art history. Fisher (2005) similarly reports, 'The PDA is at its strongest with young people in home/leisure mode. There may also be an opportunity to hook in non-visitors to museums, who like learning through entertainment and have become disenchanted with the traditional museum agenda.' The potential for engagement, however, was not limited to the young, however, as older visitors at the Fitzwilliam 'found interpretation through the PDA to be absorbing, enlightening and valuable' (Ibid.). However, Fisher also reports that the PDAs were labour-intensive for the museums because they were difficult for visitors to learn to use; for example, every visitor who used them at the Fitzwilliam needed help from staff.

Mobile phones & personal technologies

In a sense it does not make sense to distinguish between PDAs and mobile phones, since the latter have usurped all the functionalities of the former, including larger screens, wireless networking, and operating systems and applications previously found only on PCs. As a result, PDAs as a class of device have effectively been driven to extinction, except where they survive as museum guides. But there are important differences. Phones can have a persistent connection to the Internet as well as direct, person-to-person voice communication. Phones are also more likely to be carried by visitors, whereas PDAs, as in the trials reported above, are generally loaned by museums; thus the latter may not foster a sense of personal ownership by visitors, and visitors are less likely to know how to use them than they would their own phones. In addition, Hsi (2008) found that visitors were reluctant to enter information into loaned devices because they didn't know where it would end up.

Gammon and Burch (2008) suggest that the design of portable digital technologies for museums should correspond with technologies visitors are already familiar with. For example, many visitors are familiar with browsing the Web, and the use of Web conventions such as page-based navigation and hyperlinks has influenced visitors' comfort with the Dulwich (Beazley, 2007) and Tate Modern (Fisher, 2004) PDA guides. Similarly, users of portable computers at the Uffizi Gallery liked them because they associated them with personal artefacts such as diaries and calendars (Sharples et al, 2007).

There are practical problems with mobile phones in museums. Since visitors pay their own tariffs for roaming, data transmission and Internet access, there is a cost disincentive. Mobiles may be loaned by the museum; however, network service may be spotty or unavailable in the thick-walled older buildings which commonly house European museums (Reynolds and Speight, 2008; Proctor, 2007). European museums also tend to have more foreign visitors than the US for example, who incur additional charges for making international calls (Proctor, 2007).

Portable media players such as iPods are another personal technology familiar to many visitors. However, when a science centre offered iPods with video and audio clips of additional interpretative and behind-the-scenes information, half the visitors declined them, either opting for a 'real, hands-on' experience, fearing the devices would inhibit social interaction, or believing they were not technologically savvy enough. Of the half that used them however, 76 percent said that it enhanced their visit. They used the device in different ways — for example, watching a video about an exhibit before going to see it; or watching the videos at the exhibit as a group; in some cases only one group member (usually a child or teenager) used it. In most cases, the device did not inhibit interaction but had the opposite effect (Phipps et al, 2007).

Thus the perceived 'digital democracy' enabled by technology is hindered not only by both museums' and visitors' reluctance, but also financial and technical constraints. But familiar conventions such as Web browsing, and familiar technologies such as visitors' own devices, may hold promise for meaning making activities such as trails. But attention must be paid to social conventions and rituals which portable digital technologies affect and create, and these are reviewed in the following section.

Portable technologies and social isolation

A common critique of portable digital technologies in museums is that they tend to isolate visitors and inhibit social interaction. But Ling (2008) provides evidence that mobile phones in particular — which link individuals to remote acquaintances and communities — also define new kinds of social spaces and rituals. Kahr-Højland (2007) contends that mobile phones, with their social affordances, can remedy the isolating 'I-bubble' created by, for example, audio guides with headphones. Smørdal and Gregory (2005) found that students prefer using such devices more for communication than for information access.

Falk and Dierking (2008) conclude that 'most of the evaluation data suggests that the current generation of digital devices do inhibit group interaction.' There is some support for this, in particular that PDA-type devices with headphones inhibit visitors' ability to coordinate their movements and information (Hsi 2008; Fisher, 2004; Woodruff et al., 2001). Other studies in art museums (Sharples et al, 2007) and science centres (Hsi 2003; Fleck et al. 2002) have shown that users of portable digital devices interacted less with other people and exhibits. One reason is complex user interfaces; another is that in science centres particularly, visitors often need both hands to operate 'hands-on' exhibits, and even having a PDA on a neck strap proved inconvenient, according to Hsi (2008). Similarly, at a history museum, mobile phones with neck straps were also deemed by secondary students to be too heavy to carry around (Moussouri and Harris, 2009:27). One science centre eventually moved from PDAs to wireless (RFID) cards, but this raised new fears in visitors about data privacy and surveillance (Hsi, 2008).

Brown, et al (2003) created a PDA-based system which enabled visitors to communicate with other people who were remotely located and could 'virtually' visit. The location of on-site visitors was automatically tracked, and they could also send photos and text to the online visitors; both visitors used a shared website, which included a 3D model of the museum showing the on-site visitor's location. Pairs of visitors were able to jointly navigate using this system, which was designed to augment the activities used by on-site visitors (orientation, voice communication) with online resources. The authors found that users of the system tended to be more sociable than those in a conventional visit. In particular, they reported, 'Voice is perhaps the most powerful resource of all, and is used both to discuss exhibits and negotiate the visit.' However, the technology they used at the time was too unwieldy for anything other than a brief trial, with ultrasonic location sensors, wireless headphones and microphones, and a 3D virtual model.

Other research suggests that the portability of small devices can enhance social interaction. Cho (2005) reported that co-located young people prefer to gather around a shared screen than to collaborate over a network using individual screens, when given a choice. Dillenbourg and Crivelli (2006) found that portable digital devices afforded carrying findings to others to share; this proved easier than, for example, sending a picture or a link to another co-located person's phone. Vahey, et al (2007) say that putting multiple handheld screens next to each other for comparison allows students to build joint understandings; this forms part of their more general thesis that handheld devices can bridge private and public interactions. Rudman, et al (2008) found a mobile phone-based learning system to be an effective 'conversational partner' which prompted discussion among students.

Arnedillo-Sánchez and Tangney (2008) used camera phones and a concept-mapping tool to scaffold story creation, with a notebook computer and portable data projector to enable collaborative editing. The concept map was intended to act as a script. Film clips were captured on the phones and sent as multimedia messages for other students to edit. The authors report that this enabled rich conversations across different contexts, as the participants negotiated how images and sounds captured on location could best be assembled together to convey narrative intent. There were, however, technical problems with message transfer latency and the cumbersome use of multiple disparate applications.

Evidence for social isolation versus collaboration related to portable digital technologies is therefore mixed. It is an issue explored in each of the studies in this thesis, specifically the extent to which visitor-constructed trails can be personalised, collaborative, or both. Other issues for trails based on this review of portable digital technologies in museums include the use of such technologies directly at the site of visitor-artefact encounter and the extent to which they distract from, or augment, the artefacts in the context of trails; and the balance of visitor-constructed and curatorial interpretations.

2.5 Conclusion

In this chapter I have provided a working definition of museums as 'semi-formal' institutions with explicit educational missions, constraining my focus to those with collections and interpretation, exploring the design and analysis of trail construction activities across different museum types and visitor types. I have situated museums' educational roles in the broader cultural and political contexts, noting for example that visitors' expectations regarding meaning making are tied to their perception of museums as cultural authorities. I described my focus on in-museum meaning making in relation to artefacts, as against long-term learning.

Technology has been closely tied to museums' education provision in recent years, but also to political initiatives to broaden access to new visitor groups, as well as to broader cultural trends toward 'user-generated content,' and a parallel fear on behalf of museums of eroding curatorial authority. Despite the capabilities that portable digital technologies bring for visitor-constructed content, there is little evidence that visitors are willing to usurp the role of curators. As discussed, visitors do however engage in constructing content when in the context of a specific community or activity.

This review raises the following questions for research: How then might activities be designed to encourage visitor meaning making with regard to artefacts, which balance visitors' and curators' interpretations? How might technology support or enhance these activities? To what extent do portable digital technologies distract from authentic artefacts, or inhibit visitor discussion and interaction? The following chapter reviews the concept of trails as one possible activity.

Chapter 3
Literature review of trails

Based on the preceding chapter, what appears to be crucial to museum meaning-making is linkage — between artefacts and visitors, and between different interpretations and ideas. Portable digital technologies were shown to hold untapped potential for visitor construction. Thus this chapter explores the concept of trails as one way of structuring museum visitors' meaning making by providing a structure for linking individual artefacts, and constraining the focus of a visit. Such an approach augments the activity that visitors already undertake (travelling between museum artefacts) and can be supported using technologies they may already be carrying during a visit, such as mobile phones and digital audio player/recorders. As described in this chapter, 'experience recording' technology has been prototyped by computer scientists, but it has only been tested technically on a small scale, and not in pedagogically-grounded research.

The need for an adequate mental model for visitor meaning making is first discussed, followed by trails specifically, which are described in detail in terms of their historical development. Technological support for trail construction is then reviewed, with the most relevant technical implementations described in further detail. The purpose of this review is to build upon the previous chapter's survey of museums and technology, in order to inform the practical and theoretical foundation for the studies undertaken in this thesis.

3.1 The need for a mental model

Miller (1956) demonstrated that seven (plus or minus two) chunks of information was generally the maximum number of items a person can hold in short-term memory. Czikszentmihalyi and Harmanson (1999) translated this into computational terms as 'bits,' with a museum display with two artefacts, for example, requiring a visitor to use one bit of cognitive processing to choose which one to attend to. He formulated that Miller's seven bits was extensible to 126 through appropriate 'chunking' of information.

However, most researchers and theorists do not equate meaning making with quantity of data processed. Ham (1999) has shown that in museums particularly, the amount of information is not as important as the conceptual structure into which it is placed; such structures not only facilitate information integration but constitute most of what is remembered. This appears to be supported by eye-tracking research showing that visitors fixate successively, and several times alternately, on exhibits which conceptually belong together (Wessel and Mayr, 2007). According to the authors, 'This may indicate that people integrate multiple information units into an underlying concept... or at least do not process these information units independently from each other' (Ibid., 21). Gammon and Burch (2008) propose that in designing technologies for museums, the model used in the design should match visitors' own mental models. Indeed, meaning making is about model building, according to Sotto (1994). Falk and Dierking (2000) contend that 'learning processes consist of pulling together previously unconnected facts and experience, such that a new and meaningful pattern is constructed.' Similarly, Parry (2007:72) locates meaning in the connections between individual museum artefacts.

In constructing explanations and arguments, learners outline and thereby restructure their individual knowledge into a linear form, according to Weinberger, et al (2009). This mirrors what many museum exhibitions generally do — present individual artefacts within a structure which links them together to form a larger picture. A widely accepted definition of *interpretation* is 'an educational activity which aims to reveal meanings and relationships' or 'revelation based upon information' (Morrissey and Worts, 1998:152; Tilden 1957:8). Morrissey and Worts suggest that 'in the information age, the source of meaning for museums will lie in their ability to put themselves in the center of individuals' search for connections' (Morrissey and Worts, 1998:152) .

A conceptual structure such as a trail could therefore aid in knowledge construction by helping to 'chunk' information into meaningful units, and link discrete chunks together, possibly in a linear form, in order to facilitate personal or collective interpretations. For museums as well as visitors, the most common and arguably most important linear structure is narrative; thus narrative structures for meaning making are discussed in the next section.

3.2 The importance of narrative in meaning making

There is, according to McLellan (2006), substantial evidence of narrative as a meaning making tool. From an anthropological perspective, people from every known culture can mentally organize information better when recounted in the form of a story. According to Oren, et al (1988), 'When people perceive even the simplest relatedness among items, they will often — consciously or unconsciously — superimpose narrative structure on the materials.' The presence of relationships among narrative elements, according to Dettori and Paiva (2008), 'is a key point to provoke active thinking and support meaning construction.' Such relationships allow learners to infer more than is explicitly reported, hence provoking the construction of meaning; narrative therefore helps make meanings, organise knowledge, and increase motivation (Ibid.). According to Norman (1993), 'Stories are important cognitive events, for they encapsulate, into one compact package, information, knowledge, context, and emotion.' Thus as Norman (2005) as well as Bruner (2003) state, motivation and emotion are as important as cognition in meaning making.

3.2.1 Museum narratives

According to Hooper-Greenhill (2007), museums, 'using their collections, put together visual cultural narratives which produce views of the past and thus of the present' (Hooper-Greenhill, 2007:2). Museums began moving to narrative approaches in their exhibitions in the 1940s, according to Bradburne (2001), as exhibition design came into its own as a field. 'Curators alone, it was said, were unable to communicate their specialist knowledge to the new museum public' (Ibid.). In the UK, the Department for Culture, Media and Sport promotes the use of museum collections to acknowledge and tell different stories (DCMS, 2005). Mitroff and Alcorn (2007) found that visitors to an art museum web site wanted a narrative experience in accessible language — in particular, stories about the artists. 'They want someone or something to connect with as an entry point rather than a more technical or art-historical presentation.' Narratives which include interpretation, as against

explanation, are more likely to invite reflection and therefore understanding, according to Kahr-Højland (2007:133).

3.2.2 Visitors' narratives

Doering and Pekakirk (1996) believe that visitors to a museum arrive with their own 'entrance narratives' — a kind of internal storyline based on prior knowledge, which is then compared with the curatorial narrative(s) in a dialogic process. Paris and Mercer (2002) similarly report that museum artefacts serve to confirm, disconfirm, or expand visitors' personal narratives.

In a study by Macdonald (1999), visitors generated their own stories resulting from visits, which differed from the curatorial themes and were linked to the ways in which the interpretation was mediated. This follows decades of visitor studies research resulting in the finding that no matter how well-designed an exhibition, visitors do not necessarily follow the curatorial narrative, and instead construct their own interpretations, according to Hooper-Greenhill (2007:27). On the other hand, visitors with low subject knowledge willingly allow the museum to structure their visit to a certain extent (Smith and Tinio, 2008). Thus, there would seem to be scope for structuring visitors' personalised or collaborative knowledge construction. According to Pierroux, et al (2007):

> New technologies are creating new contexts for understanding artefacts and shaping visitors' activities, with *narrative* playing a central mediating role. From a meaning making perspective, such technologies provide new opportunities for what Wertsch (2002) calls 'narrative production' and 'narrative consumption' in museums. (Pierroux et al, 2007; emphasis)

The next section identifies lessons to be learnt from existing museum-provided trails; then visitor-generated trails are introduced.

3.3 History of trails

'Traces and trails are a self-orienting device to help people in transit — or minds in motion — be grounded and able to return,' according to Ackerman (2006).

3.3.1 Non-digital museum trails

According to Parry (2007), museums were born as spatial representations and arrangements of knowledge. Falk and Dierking (2008:22) state that 'being able to confidently navigate within a complex three-dimensional environment turns out to be highly correlated with what and how much an individual learns. Similarly, intellectual navigation has been shown to affect visitor meaning-making from museums.'

Some museums make thematic structure explicit with 'advance organizers' and orientation guides — though interestingly, much museum-produced media lacks indexes, maps or other organizing tools, according to Semper (1998:121). Some museums author themed trails for school groups, families, or individual visitors, a practice which dates to the 19th century. These are typically printed on paper in single sheets or booklets, direct visitors to particular places in the museum, identify things for them to look at and for, and usually specify activities to carry out. Aimed mostly at early years and primary aged children, these often take the form of themed treasure hunts or 'I Spy' games, though they can also include drawing or writing tasks, and/or prompt thinking or talking. According to one evaluation, families enjoy and learn new things from these trails, and in particular the trails act as a focus for whole-family engagement (Drewitt, 2006). Thus they are not just for children, and this supports Ash's (2002) finding that family groups are viewed as providing 'scaffolding' to young visitors to some extent. In particular, according to Drewitt (2006), trails prompt family groups to look longer and more closely at exhibits, lead them to discover new artefacts or galleries they might otherwise overlook, and stimulate discussion and interaction within the family. Because there is generally no fear of assessment or time constraints (besides museum visiting hours), trails support Falk and Dierking's (2000) notion of 'free choice learning' to some extent. In Drewitt's (2006:5) evaluation, 'When given the opportunity to comment openly, families identified a wide range of learning outcomes.'

Figgitt (2007) reports, from collected research and practical experience, that backpack trails — typically a printed trail for young visitors with supplementary activities and/or handing artefacts — tend to work best when a family works together on them, when the number of activities is limited to between five and seven activities, and when the trail has a clear theme.

While paper-based trails in museums have developed over the past several decades, a parallel technological development regarding trails has occurred, which has only recently been applied in museums. This is detailed next.

3.3.2 *Bush's* Memex

The human mind, according to Bush (1945), 'operates by association. With one item in its grasp, it snaps instantly to the next that is suggested by the association of thought, in accordance with some intricate web of trails carried by the cells of the brain.' To aid in research, he envisioned the *Memex*, a technology-enhanced desk containing a wealth of information, with effectively unlimited storage capacity for recording more. 'Books of all sorts, pictures, current periodicals, newspapers, are thus obtained and dropped into place' in the form of microfilm rolls. For visual capture it would have the pre-digital equivalent of a flatbed scanner, stylus input, and audio recording capability. It would have multiple 'windows' such as are common today in computer interfaces, for simultaneously viewing different sources. It could be operated from a distance, with audio recording via radio. The essential feature, however, was its indexing capabilities: 'The process of tying two items together is the important thing,' according to Bush. A researcher could connect records to make a trail, name the trail, and call it up later. 'It is exactly as though the physical items had been gathered together from widely separated sources and bound together to form a new book.... It is more than this, for any item can be joined into numerous trails' (Bush, 1945).

3.3.3 *The World Wide Web*

Based on his concept of trails, many researchers regard Bush as 'the father of hypertext,' and the World Wide Web as a realisation of his vision of the Memex, albeit in massively distributed form. It is now taken for granted that the computer is a medium which, through networking, provides access to information stored remotely. That the Web has now made vast amounts of information available is undisputed. Its continued exponential growth, however, comes with an increasing need for editing and filtering, and an increasing importance of navigation, according to Darken and Peterson (2002). The problem of getting 'lost in hyperspace' they claim, is similar to navigation issues in physical spaces. Manovich (1999) calls the Web an 'anti-narrative space' in which continuously added new elements add up to a collection, not a coherent story.

Peterson and Levene (2003) propose that a museum is analogous to a digital hypermedia environment, similarly containing a large amount and wide range of information in various forms, organised in a semi-structured information space which can be browsed in a nonlinear fashion. Just as learners with little or no prior knowledge about a domain tend to need more navigational and instructional support in a hypermedia environment, according to Gerjets and Kirschner (2008), in a

museum environment, most visitors, who have little or no domain knowledge, welcome a degree of structure by the museum (Smith and Tinio, 2008). As Gerjets and Kirschner observe however, most of the reported findings regarding hypermedia environments have been in closely controlled experimental conditions, not in physical environments such as classrooms or museums. Therefore, research is needed to investigate how much navigational and instructional support is needed by different kinds of visitors in museums.

3.3.4 Trails and 'navigational learning'

Peterson and Levene (2003) turn to technology itself to address the problem of navigating large amounts of data, drawing directly from Bush (1945). They propose a model which regards trails of 'learning objects,' not the individual objects, as a unit of analysis. 'Navigational learning,' they propose, consists of trail enactment (the experience of constructing a trail) and editing (planning, reflecting, reordering a trail). The core concept of navigational learning is that a learner creates and edits a trail, and can then share it with others. What is shared is not merely a list of resources, objects or places, but a linear path which places these objects in a spatial, temporal, and/or categorical context. Systematic recording and representation of a trail makes its use and sharing easier.

Peterson and Levene (2003) provide the following scenario:

> Imagine that you are a teacher organizing a museum visit for a group of students. There has been some previous preparation and discussion, and the task to be completed after the visit is to write an essay on the links between ancient Greek and Roman sculpture. You all arrive at the museum, and the students wander through the exhibits, sometimes finding their own path, sometimes following a guidebook, sometimes discussing and making notes as they go. You leave the museum and the next day in class you hold a discussion in which students describe what they saw and how they interpret it. The students then take their notes, their memories, their discussions and their guidebooks, and set about developing their essays. (Peterson and Levene, 2003)

Digital technology, they continue, can support this process as follows:

> In addition to classroom preparation for the visit, the students may be able to log on to the part of the museum's web site relevant to the visit. On the web site they see the layout of exhibits, and perhaps some standard recommended trails, represented in a form which is consistent with that of the trail record which they will be given on leaving the museum. As described above, the students are given an *experience recorder* on arrival, and the web address of their personal trail record on leaving: a representation of their navigation of the museum's ecology. Back in class, discussion is facilitated by projecting several students' trail records on the wall simultaneously, providing a basis for discussion, explanation and debate. And when asked to write an essay, students use their trail records as a starting point, using computer tools to extend, refine and transform them into a finished document. In this way, the proposed technology makes actual and possible trails both explicit and manipulable, thus facilitating both the private and interactive aspects of navigational learning. [Ibid.; my emphasis — experience recorder is detailed below]

Bush (1945) envisioned that researchers would share trails thought to be of value to each other. His long-term vision was as follows:

> There is a new profession of trail blazers, those who find delight in the task of establishing useful trails through the enormous mass of the common record. The inheritance from the master becomes, not only his additions to the world's record, but for his disciples the entire scaffolding by which they were erected. (Bush, 1945)

Bush's use of the term 'scaffolding' differs from its use in activity theory, by Vygotsky (1978) for example, which is detailed in the next chapter. But in both cases, scaffolding relates to knowledge construction in which a more able learner supports a less able one; for Bush the disciple inherits knowledge for the master, and for Vygotsky the master helps the disciple construct his or her own knowledge. As regards museums, this is related to the balance between curatorial and visitor-constructed interpretation. For Vygotsky, scaffolding requires a co-located master and disciple. But more recently researchers (e.g. Luckin, 2008) have created software intended to provide on-the-fly scaffolding in a Vygotskian sense, but in the absence of a human master. This, in turn, mirrors the way Pierroux (2005), also grounded in activity theory, conceptualises museum meaning making, — a visitor's discourse with curatorial knowledge, even in the absence of the curator, can be scaffolded to

the degree that discourse is guided and supported by other means. The technical means of supporting trail construction is detailed in the next section.

3.4 Technical support for trails

The concept of trails was further developed in a 2004 project led by Levene (see Schoonenboom et al, 2007). The trails process was expanded to include construction (enactment), reflection (editing), and collaboration (sharing). In the trails project, trails were investigated in various domains; however in all cases they were focused on easily-assessed formal subjects such as mathematics, physics, and language learning; and in all cases the research was performed in virtual, not physical, environments. The project was grounded in a computer science perspective, aiming to classify and quantify the learning process so it could be processed by a computer, with the aim to create adaptive computer-aided instruction materials. Nonetheless, their definition of 'learning objects' is described next, for its relevance to this thesis.

3.4.1 Learning Objects v. museum artefacts

Learning Objects (LOs) have become a common term in e-learning. In the trails project, Schoonenboom, et al (2004) defined them as 'cohesive pieces of learning material that are usually stored in a repository, allowing teachers and learners to search for LOs of interest to them. Learners engage with LOs in the form of trails — time-ordered sequences of LOs' (Schoonenboom et al, 2004:3). There are formal specifications for digital LOs, but these descriptions are general and technical in nature, and are based on the assumption of learners who are physically stationary. Beyond general definitions however, there is no agreed-upon definition of exactly what a LO is. As Brown (2006) observes, the various definitions of LOs can encompass a single paragraph of text, a static picture, or a complete interactive program.

In the trails taxonomy created by Schoonenboom, et al (2004), LOs are classified as either digital or non-digital, with museum artefacts given as an example of the latter. Though technical definitions of LOs were not intended to include real objects, museum artefacts generally conform well as objects of learning value — generally static but filled with 'content' in various ways. Meaning making with physical artefacts, as for example described by Dewey (1938), differs significantly from meaning making with digital objects, and Schoonenboom, et al classified analog LOs in order to provide a

means of including physical artefacts in a digital trail. The authors suggest that non-digital LOs such as museum artefacts could link to digital LOs by means of a 'digital placeholder' such as a digital file on an audio tour; alternately, digital results such as notes made in an electronic diary could be generated about the artefact.

Analog means of capturing aspects of a museum visitor's experience have been used from museums' inception, including writing and drawing on paper; sketchbooks have long been used in museums and drawing is viewed as aiding understanding of artefacts, as well as aiding meaning making in a wide range of subjects (Brookes, 1996; Edwards, 1979). Sketchbooks are specifically used by particular visitor groups, such as art and design students (Cook et al, 2010). Postcards and exhibition catalogues purchased in museum shops also serve as paper-based *aides de memoire* extending visitors' experience beyond the visit. But, as noted in the previous chapter, few visitors now carry sketchbooks to museums or elsewhere, whereas most people carry some sort of personal digital device. This thesis therefore examines trails as a structure for utilising such devices for supporting meaning making in and from museum visits.

Bush (1945) envisioned a mobile user of his Memex, able to add annotations via a wearable camera device attached to a pair of eyeglasses, with wireless radio transmission to the researcher's desk-based Memex. Everything would be time-stamped in order to facilitate easy synchronisation, as is common in digital capture today. Peterson and Levene (2003) describe a digital 'experience recorder' for capturing elements of an experience such as a museum visit. Levene and others have prototyped various features of such a recorder, but it has only been tested technically and on a small scale, and not in pedagogically-grounded research. This and related implementations are detailed next.

3.4.2 Review of digitally-augmented trails in museums

Several technical systems have been tested which support trail recording to varying degrees, either explicitly or not. Few have focused specifically on visitor meaning making, and two systems which have done so receive a more detailed review at the end of this section.

Brown, et al (2005) describe a system in which visitors to the main public square in Glasgow are able to see on a tablet computer the paths that previous visitors have traveled, along with their own location, photos taken and related web pages viewed. Previous visitors' paths were compared with the current visitor's path by the system, in order to create recommendations based on places other people

visited and media they had created. However, the user could not shape the trail into a narrative or other form to be shared or re-used.

Parry (2007) describes the 'LIVE!Labels' system which aimed to replace traditional printed museum labels with screen-based labels which could be updated in order to, among other things, provide trails linking multiple artefacts. However, it was found after nine weeks of testing that only 20 percent of visitors even looked at the labels, and of those, only 20 percent realised they were 'live'. Curators treated them more or less as static labels, updating them less frequently than, for example, their own personal web pages.

Rudman, et al (2008) describe a 'Context Aware Gallery Explorer' tested in the Uffizi Gallery in Florence. It consisted of location-aware portable digital technologies which tracked visitor movement and timing information, then suggested related artworks based on this data. A control group visited with a printed guide, both groups were observed, and both completed a survey at the end of the visit. The authors found no significant differences in 'learning' between the two groups, based on self-reporting, and this was attributed to the fact that both digital and printed guides contained the same content. However, the digital group was observed to spend more time at paintings studying details, prompted by the device, and also engaged in more conversation. While the devices traced users' locations, their trails were not explicitly represented to them, nor could they edit or share them.

Bletchley Park museum enables visitors to use their own mobile phones to 'bookmark' particular exhibits by sending a text message. At the museum's web site, the visitor can enter his or her mobile number, and get a list of the exhibits bookmarked, along with thematic trails linking from each bookmark. The museum had decided that much of its collection (related to code-breaking during World War II) was better suited to post-visit reflection; it has an extensive archive including many interviews, with strong narrative themes. Thus when the visitor goes to the web site to retrieve the bookmarked exhibits, these are presented as individual 'stories,' with additional stories listed in the relevant topics, with 'story connections' through the archive connecting several topics. Linked topics are suggested based on statistical co-occurrence. Keywords are used to automatically make the links between individual resources. Users can also make their own links, and the system thus includes both 'top down' and 'bottom up' methods for linking curatorial and user-generated content. In a trial of 35 students, 20 went back to the web site after the visit (though it was not clear whether this was prompted by a teacher). The students were tasked to write essays based on their visit, and some of those included concepts which were not presented during the visit, but were present on the web site. (Mulholland et al, 2005)

Following on from the description of trails by Peterson and Levene (2003), Levene and colleagues have developed the technical aspects of trail recording further, in both virtual and physical spaces. An initial implementation of an 'experience recorder' relied on automatic tracking of visitors' locations in a museum, on the assumption that a trail record would act as a memory aid to support reflection (Roussos et al, 2005). As described in Baker, Roussos and Levene (2006), one version of this system exploits the Bluetooth wireless protocol built into most mobile phones; since each phone has a unique identifier, it can be tracked as it moves around a physical space by means of Bluetooth access points in different locations. A system with such minimal user interaction was termed 'non-interactive' (Winters et al, 2005); however, the system also allowed the active 'bookmarking' of locations by the visitor, plus capture of images, audio or video, which could be linked to the automatically recorded location information (Baker et al, 2006). A simulated image generated by this system is illustrated in Figure 3.1.

Figure 3.1 Simulation of automatically recorded trails at British Museum, from Winters, et al (2005).

Several practical problems arose from these investigations. One was that the system generated huge amounts of quantitative data, requiring considerable storage and computational resources; reconstructing an accurate trail of a single visit required filtering out spurious data points and developing a complex 'interaction tree' algorithm (Papadogkonas et al, 2006). More problematic for research is that museums were reluctant to test such a system, because of technical requirements as well as ethical concerns about visitor privacy. In addition, the system relies heavily on quantitative location information, not qualitative data related to visitors' interpretations. While location-tracking

technology can be very precise, without personal interpretation it could be meaningless, if for example a visitor is in front of a particular artefact but facing the other direction. As Keenoy, et al (2004) succinctly put it, without additional data it is difficult to distinguish proximity and interest. Such a system thus risks treating human 'users' as mere 'factors' in a technological system, rather than 'actors' with skills and intelligence who can actively accomplish goals (see Bannon, 1991).

iGuides

Beazley (2007) conducted trails at Dulwich Picture Gallery from 2004 to 2009, using web-based trails created by her and accessed by secondary students on portable digital devices in the gallery. 'There is absolutely no doubt in my mind,' she reported, 'that if the trails are carefully and appropriately made, challenging, fun, unstuffy, careful to initially direct the child and then allowing them to run or wander where they want, this method far surpasses any other used so far.' A former teacher, she structured these trails herself, starting with a stress on observational skills, then adding progressively more reflection. Her trails utilised a similar approach to all the artworks, so that students could make comparisons. She reported that students generally liked them: for example after a 'symbols' trails which pointed out hidden meanings of particular elements in paintings, students were proud of the 'insider' knowledge they gained.

However, while the trails were self-paced and students did not have to visit each painting, students often felt pressured to complete the entire trail. One teacher suggested investigating only two paintings in order to alleviate this pressure. Students' trail data was captured, in the form of text-based responses to questions on the screen, but this data was not re-used in anyway.

My Art Space / OOKL

My Art Space (myartspace.org.uk, later renamed 'OOKL,' www.ookl.org.uk) is a system designed to make a school visit to a museum part of a sequence which includes classroom preparation; collecting information and evidence during a visit; then reflection, editing and sharing afterward. A teacher frames the visit beforehand by setting a task for students, usually in the form of a question or hypothesis. Students then collect evidence during the visit. Mobile phones with bespoke software provide a link between classroom and museum by enabling students to collect evidence and

information in the form of photos, text and audio clips, all of which are placed on the My Art Space web site in a time-ordered sequence which is, effectively, a trail.

After the visit, students can log in on the web site to view, edit and share their data, in a linear 'gallery' similar to a Microsoft Powerpoint presentation. This can then be presented in class or published online. Students can change or add text to photos, upload new content, change the order of their captured and collected 'objects,' change the color and fonts in their gallery, and create new galleries. Teachers and museum staff have additional facilities on the site to create content and structure visits, and all content is moderated so that, for example, no student-created content goes to the public area of the site unless approved by the teacher. The service relies on both museum and teacher to structure the visit.

In one evaluation of the system, CETADL (2006a) reported that the system served to focus students' attention on artefacts at the museum. A teacher said that the phones not only excited the students more so than digital cameras, it also provided support and automatic uploading that cameras could not. However, in a focus group afterward, when asked what they had learned, the students mainly replied that they had learned about phones, cameras and the Web; not about art, collecting or curating. Thus technological distraction remains an open issue, and is addressed in the studies in this thesis.

In another trial (CETADL, 2006b), a teacher said, 'The biggest value was in the enhancement of the museum visit itself. The students moved around the museum much slower, taking more notice of the exhibits. Overall, lots more learning took place.' (CETADL 2006b:25) She added that the system encouraged students to ask questions, helped them deconstruct artefacts, and reflect on their learning. 'They came up with their own ideas more than if the teachers had provided information instead of a museum visit.' (CETADL 2006b:24) Another teacher added, 'if you structure it right you'll get the learning' (Ibid.). The students themselves said in a post-visit focus group that they had learned more, and that the technology served to focus them in on particular artefacts. They also appreciated that they did not have to worry about taking in the entire museum; since some data was captured, they could explore it later. No definition of learning or pedagogical theory grounding the studies was specified.

Interesting group dynamics were reported. Students were initially put into mixed-ability pairs (each student with a phone), but changed to friendship groups when in the museum, working in threes or fours; a teacher then put them back into pairs. Students either divided the work evenly (for example

taking turns collecting data), or one tended to do all the work, depending on how well the pair knew and liked each other. Students spent 2.5 hours in the museum, working in pairs, but after about an hour they went off-task.

Since students were instructed to collect evidence before forming a conclusion, they collected as much data as possible, resulting in a large number of data on the web site. The researchers reported:

> This leads us to think that the task for the visit needs to be more structured, and more preparation to meet the learning goal of the visit is necessary if the collection is to be a meaningful task requiring reflection and decision making rather than a frenzied activity of collecting items 'just in case'. (CETADL 2006b:9)

Another study using the system (Moussouri and Fakatseli, 2009; Moussouri and Harris, 2009) was grounded in a traditional visitor studies approach (as described in Chapter 5), and used the system with KS3 and KS4 pupils at the National Maritime Museum. The researchers' methodology included focused observations and tracking, audio and video recordings of student conversations, semi-structured interviews, field notes and focus group discussions. Data were analysed across four broad categories: agenda (teacher and student expectations), planning, communication, and technology.

The authors reported that students and teachers alike felt that the use of phones saved time and was easier and more enjoyable than using traditional clipboards and worksheets. Yet teachers also expected that the phones would facilitate in-depth learning and regulate student behaviour during the visit. For their part, pupils were not as clear about their expectations of the phone-based system, with most of them expecting to use a traditional audio guide. Afterward they compared their use of the system to writing an essay, viewing the phones as easier, faster and more interesting. These findings support Gammon and Burch's (2008) assertion that mental models for technology design should match users' expectations; in this case the technology was compared with paper-based resources and known digital resources such as audio guides.

Students in the study also thought the phones made the visit more engaging and therefore more worthwhile. They liked taking pictures in the museum since it is not usually allowed, and associated the phones with this new privilege. Yet the main problem reported by students was poor lighting in the gallery which, in combination with the reflecting glass cases and the automatic flash on the phone camera, made taking pictures almost impossible. Teachers suggested pupils should be told not to take pictures of poorly lit artefacts, as they could find better images on the museum's web site.

All the students in the study owned mobile phones already, and felt the technology was more appropriate to their age group than audio guides or PDAs — thereby associating the latter two with older visitors. Students were observed to take turns using the phones, and 'working in pairs, pupils shared ideas about what is the most effective use of the hand-held device to complete their task and engaged in discussions about which objects and other resources they should select to help them answer their question.' (Moussouri and Fakatseli, 2009b:25). However, when there were connectivity problems the students regarded the phones as 'a waste of time' (Ibid., 26).

Despite some methodological problems and minimal theoretical grounding in the studies discussed in this section, My Art Space, as a purpose-built learning tool with teacher support and multiple media capture capabilities, is suitable for use in trail-like construction activities, and is therefore used in one of the studies in this thesis, described in Chapter 7. The other two studies focus more on the trails concept itself, and utilise simple digital audio recorders. The other systems described in this section were small-scale research prototypes, and/or had technical or logistical limitations and thus were not considered for use in this thesis.

3.5 Conclusion

In this chapter I have presented evidence for structuring a museum visit, starting with the need for a mental model, particularly a narrative one, for linking together individual artefacts encountered by visitors. I have proposed trails as one such model and reviewed the history of, and literature associated with, the concept. I have also reviewed portable digital technologies for 'experience recording' supporting trail construction, and some initial implementations and findings in this regard.

Based on the preceding review, there appears to be scope for researching the potential for digitally-augmented trails to structure museum meaning making. Further research is required about how portable digital technologies in general, and particular media such as audio, photos and text, mediate visitors' meaning making in the context of trails. Along with technological mediation, the issues of personalisation and collaboration need to be investigated. An exploration of context — both visitors' own and the museum context — is needed to ground trail-based meaning making. Thus the next chapter explores notions of context, and develops a conceptual model for the design and analysis of visitor-constructed, technology-mediated museum trails. Chapter 5 then describes the research design and methodology, which is then investigated in the empirical studies which follow.

Chapter 4
Theoretical framework

Following on from the the review of museums and technology in Chapter 2, and the review of trails in the previous chapter, in this chapter the theoretical perspective underpinning this thesis is detailed, informing the development of a conceptual model for the design and analysis of trail construction. This contributes to the aim of this thesis, to explore how people make meanings in and from museums through the construction of trails using digital technologies, by grounding the design and analysis of trails in sound pedagogical theory. As such, the conceptual model is drawn from theory relevant to meaning making in museum contexts, which is itself grounded epistemologically in a theory of knowledge which regards meaning making as a process of active construction of visitors' interpretations of artefacts. This in turn informs a methodology for investigating the research questions, with specific methods which are detailed in the next chapter.

Roughly following an approach detailed by Crotty (2003), I begin by laying an epistemological foundation, making a distinction between constructivism and constructionism, two related epistemological approaches which underlie the theoretical perspective which is described next, the Contextual Model of Learning by Falk and Dierking (2000). This is situated within a discussion of the role of context in museum meaning making. The methodological approach, activity theory, is discussed next. From this foundation, a conceptual model specific to visitor-constructed museum trails is developed, which is tested and iterated in the three studies in this thesis.

4.1 How this chapter is structured

Crotty (2003) undertakes a detailed analysis of the theoretical underpinnings of the research process, and posits an approach to research in which a particular object of study is investigated using particular methods, which are determined by a specific methodology — a strategy or process underlying the methods. The methodology is, in turn, grounded in a particular theoretical perspective which holds some philosophical assumptions about the nature of reality. This theoretical perspective is, in its turn, informed by an epistemological stance — a theory of knowledge, of explaining how we know what we know, and the process of coming to know. Crotty's approach is depicted in Figure 4.1.

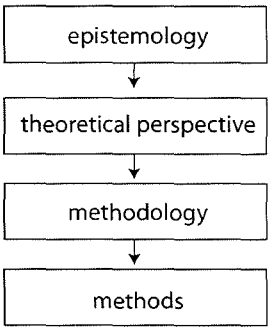


Figure 4.1 Four elements of social research, from Crotty (2003:4)

According to Crotty, every research project is unique and thus may necessarily utilise different methods, methodology, theory and epistemology which are best suited to investigating the particular phenomena and research questions in each case. As this thesis investigates museum visitors' activity with regard to meaning making, ethnographic methods such as participant observation and unstructured interviewing are utilised, as described in the next chapter. These are grounded methodologically in activity theory (discussed in Section 4.5), as informed by Kaptelinin (2008) and Pierroux, et al (2007), who believe activity theory to be best suited to studying meaning making by museum visitors. Nardi (1995), who compares various perspectives, determines activity theory to be best suited to studying context. Context is an important aspect of meaning making in museums, yet it is also a complex concept, being interpreted variously, depending on theoretical perspective and research area. It is therefore discussed at length in Section 4.3. This leads into a description of the theoretical perspective utilised in this thesis, the Contextual Model of learning, in Section 4.4.

This is a slight departure from Crotty's (2003) approach and risks generating some confusion, since the Contextual Model, as a theory, does not underlie activity theory as a methodology. Yet in this

thesis, the Contextual Model serves as exactly what it describes — a rich model of the museum context. While it suggests particular methods (detailed in the next chapter), it is treated primarily as a theoretical perspective on meaning making which is specific to museums. Activity theory, by contrast, is oriented toward studying activities which are mediated by tools, from a socio-historical perspective — aspects which are not covered by the Contextual Model, as described in Section 4.4.4. For its part, activity theory is not strictly a 'theory' despite its name, according to Bannon (1997), but acts as general research methodology, specifically through its concepts of development, mediation, the object hierarchy, and internalisation/externalisation (Kaptelinin and Nardi, 1997); these are channeled into particular methods by Kaptelinin and Nardi (2006) which are used in this thesis. As described in Section 4.6 and investigated throughout the studies in this thesis, these two approaches are complementary for investigating technology-mediated museum activities aimed at visitor meaning making, the Contextual Model broadly serving as a theoretical perspective, and activity theory broadly serving as a methodological basis. Both the Contextual Model and activity theory are firmly grounded in the epistemology of constructionism, as defined by Crotty (2003). In the next section I discuss this epistemology, distinguishing between constructivism and constructionism, both of which are relevant to this thesis.

4.2 The epistemology of knowledge construction

The theory of knowledge underlying most approaches to contemporary social research, according to Crotty (2003), is the stance that meaning is constructed in our engagement and interaction with the world, and is developed and transmitted in a social context. This is distinguished from subjectivism, a view underlying much of postmodern and critical theory, which holds that a subject *creates* meanings and imposes them onto an object. In constructivism, meanings are not created, but are always constrained by the qualities and history of an object; this involves imagination and creativity, but is always directed toward some object, and the object, in turn, is shaped by our consciousness (Crotty, 2003:44). Thus while reality may exist ontologically outside our consciousness, its *meaning* is constructed in a dialectic relationship between subject and object. This necessarily involves language and concepts which are culturally embedded in our consciousness; hence culture is a source, not an outcome, of human thought and behaviour, according to Crotty. He recognises that 'culture' is 'shorthand in most cases today for a very complex mix of many cultures and subcultures' (Crotty, 2003:55).

Constructivism has broad empirical support. For example, according to Roschelle (1995), 'A large body of findings shows that learning proceeds primarily from prior knowledge and only secondarily from the presented materials.' There is support for active learner construction in fields as disparate as mathematics (Wilensky, 1993; Resnick, 1983) and art (Vygotsky et al, 1971). Elliott and Gordon (2006:35) report that 'contemporary research into the inner structures and processes of the brain supports many of the basic tenets of constructivism.'

4.2.1 Constructivism and museums

Although Crotty uses 'object' in a hermeneutic sense, it is clear that with regard to meaning making in museums, object and artefact are often indistinguishable. In both cases, meaning takes the form of particular interpretations constructed by subjects. Hooper-Greenhill (1999a) views this in the context of hermeneutics as a negotiation of meaning between visitor and artefact. Paris and Mercer (2002), following Dewey (1938), conceive of these as 'transactions' between visitors and artefacts; in negotiating such transactions, visitors search for features of their personal lives (whether real or imagined) to confirm or elaborate their own identities. Cohen and Manion (1994) characterise these as 'personal constructs.' Czikszentmihalyi and Harmanson (1999:152) views this construction process as a dialectic between the integration and differentiation of new and existing knowledge, placing emphasis on the conscious choice between various possibilities as the means for meaning making and growth.

Any interpretative information provided by a museum colours a visitor's meaning construction; in essence it tells the visitor how to look at the artefact, and according to Reynolds (2007), most educational interventions in museums are oriented toward developing strategies for looking at artefacts. Crotty, for example, tells how Fish (1990) presented a simple list of names to his university students as a religious poem, and they ably interpreted it as such; according to Fish, the meaning they ascribed to it was no less valid than its 'true' meaning as a list of authors intended for students in another class (Crotty, 2003:45-48). Similarly, museum artefacts can be subject to widely varying interpretations by visitors, depending on how the artefacts are labeled and described by the museum, as detailed by Bradburne (2002). According to a constructivist epistemology, there are no true interpretations, only useful ones (Crotty, 2003:47).

Museums have enthusiastically embraced constructivism, at least on the surface. Hein, in *The Constructivist Museum,* writes that such a museum 'should make a conscious effort to allow visitors

to make connections between the known and the new' (Hein 1998:157). But while they accept the basic tenets of constructivism on the surface, museums have always had problems with it, because of their political role as perceived cultural authorities, as discussed in Chapter 2. To accord visitors with the power to construct their own meanings is to undermine museums' curatorial authority. In so doing, according to Mezaros (2006), a museum absolves itself from interpretive responsibility for the meanings it produces and circulates in the culture. 'If the [constructivist museum] is taken to its logical conclusion,' says Fritsch (2007), 'then surely there is no museum knowledge except for that which the visitor constructs in his or her head.' This extreme formulation is known as 'radical constructivism.' Von Glasersfeld (2007, 1993), for example, views knowledge itself as a construct, and therefore believes it is impossible to know which, or whose, knowledge reflects ontological reality; knowledge can therefore be located in entire communities or systems, including those mediated by technology. To museums, the democratisation of curatorial knowledge, accelerated by digital, networked technologies, as discussed in Chapter 2, is perceived as radical indeed, posing a threat to their authority — just as digital technologies are more broadly seen to challenge the authority of schools and mass media. Yet as noted in Chapter 2, the rapid spread of the Internet has not so far eroded public perception of museums' authority as arbiters of knowledge, nor has it reduced the number of physical museum visits. Thus, one of the issues explored in this thesis is the balance of curatorial and visitor-generated knowledge desired by, and useful to, museum visitors as they construct meanings from artefacts.

Social constructivism, an expanded form of constructivism, takes into account the social and cultural perspectives of individuals and groups, and how meaning is made within a complex environment. The social construction of knowledge has ample support, at least in theory. Falk and Dierking (2000) see meaning making as distributed, with an individual learner inseparable from the content and context; while individuals may construct their own meanings, these are mediated through the various communities which shape their lives. Similarly for Lave (1988:1), cognition, as observed in everyday practice, 'is distributed — stretched over, not divided among — mind, body, activity and culturally organized settings which include other actors.' According to Salomon (1993:1) 'knowledge is socially constructed through collaborative efforts to achieve shared objectives in cultural surroundings'. Thus according to Crotty (2003:57), the social is embedded in both subject and object.

This does not mean that visitor meaning making is more effective in shared, as opposed to solitary, encounters with museum artefacts, according to Pierroux (2005). Rather, she says, meaning is constructed through human activity which is always socially situated — often through discourse, either explicit or implicit, and mediated by language. Museum curators, for example, can be seen to

mediate visitors' encounters with artefacts through interpretive materials even when the curators are absent. In these situations, 'it is the way in which discourse is guided and supported that is most significant for meaning making activity' (Pierroux, 2005).

4.2.2 Constructionism

Crotty (2003) discusses 'constructionism' in the sociological tradition, with roots in Marx's dialectical materialism and Dewey's emphasis on experience. Crotty distinguishes *constructivism* as an epistemology of individual meaning making, from *constructionism* as a social phenomenon. But another usage of the term 'constructionism' comes from Papert (1991, 1980), who based it on the work of Piaget (1969) — neither of whom are referenced by Crotty, but whose work is relevant to visitor-constructed museum trails.

Papert shapes the epistemology of constructivism into a distinct pedagogy. In his definition of constructionism, 'learning is most effective when part of an activity the learner experiences as constructing a meaningful product (Papert, 1987). This approach regards tangible objects created by learners as 'things to think with,' and digital tools, in particular, are considered not only to broaden the scope for construction but also to highlight mental models as well as the environment in which construction takes place. While pedagogical constructivism has its roots in Piaget's (1969) notions of child development, Papert's constructionism is an epistemological stance about learning how to learn, according to Ackerman (2001). It is similar to museum meaning making approaches in that it locates meaning making in a constructive dialectic between learner and artefact; as in Vygotsky's social constructivism (described in Section 4.5) this dialectic involves the internalisation and externalisation of ideas. Yet this definition of constructionism differs from other approaches in that it focuses on inventing — whether a physical thing or a theory of how the world works. A trail could be considered such a product of construction, and therefore I use Papert's definition, not Crotty's, in this thesis.

According to Ackerman (2001), Papert's constructionism also pays special attention to tools and context, while Piaget's constructivism tends to overlook them. Indeed, a danger of constructionism is that it can appear overly focused on technological tools, and this thesis focuses not on technology as such, but on structuring visitors' mediated encounters with museum artefacts. Vygotskian activity theory focuses on tool use in context, but as Ackerman observes, its epistemological stance is oriented toward moving from the physical or external to the mental or internal. Constructionism, by contrast, maintains a view of knowledge as both embodied and situated in local contexts, and this too

suits museum meaning making in which movement and physical space play such an important role, as detailed in Chapter 2. Yet very little research in museums has been grounded in a constructionist epistemology, as defined by Papert. This thesis attempts to address this imbalance.

Thus, further attention must be paid to the local museum context, particularly as affected by mediating and constructive technologies. Differing notions of context are therefore discussed in the next section, leading to the succeeding description of the Contextual Model of Learning.

4.3 Approaches to context in theory and practice

Context has become an increasingly important area of research in the technology community. It has usually referred to the physical context — specifically with regard to location awareness — but Dourish (2004) has argued for the social context to be included as well, and in fact in the last few years, socially-aware mobile applications have been increasingly developed which parallel the rise of social networks on the Web.

In the last few years, too, a body of research around 'mobile learning' has grown rapidly, and contains relevant findings and insights for visitor-constructed trails in museums. Mobile learners are seen to be situated in, and moving across, physical contexts such as museums, schools, homes, and in-between. The tools they use are viewed by researchers as helping them work with information, knowledge, understanding or skills in various physical contexts, and to carry those things across contexts (Wali et al, 2008). According to Roschelle and Pea (2002), mobile learning applications can integrate 'typological' (categorical or abstract) representations with 'topological' (physical/spatial) representations. This matches Parry's (2007) characterisation of museums as physical spaces for organising knowledge (discussed in Chapter 2), and the concept of trails as described by Peterson and Levene (2003) and detailed in the previous chapter. Portable digital technologies could therefore support trail construction not only by capturing aspects of visitors' experience, but also by representing a trail as a physical or conceptual topology.

Byrne, et al (2008) report that 'Ten years of research into mobile learning has revealed no single "killer application" for mobile technology in learning.' Similarly, no single theoretical perspective for either the design or analysis of mobile learning activities has been widely accepted. One of the most prevalent theories, however, has come from Sharples (2005). While he acknowledges the techno-centricity of most mobile learning approaches, he contends, along with Kondor (2008, 2006) and

Nyíri (2002), that the development of technology can influence theory as much as theory can ground technology design and use. Based on this, he characterises learning in the 'mobile age' as 'conversation in context.' Portable digital technology, according to Sharples, 'provides a shared conversational learning space, which can be used not only for single learners but also for learning groups and communities' (Sharples, 2005:5). He draws from Dewey: 'Not only is social life identical with communication, but all communication (and hence all genuine social life) is educative' (Dewey, 1916; in Sharples 2005:1).

In shaping this theory into a model for analysis, Taylor, et al (2006) draw from activity theory (discussed in Section 4.5) as a means of studying the context of mobile learning. For the authors, context constitutes the combined physical, informational and social setting of meaning making which is in continual change:

> All activity is performed in contexts, and these are historic constructs. Cole (1996) makes an important distinction between context as 'that which surrounds us' and context as 'that which weaves together.' Activity is not only occurring *in* a context, but it also *creates* context through continual interaction and change. (Taylor et al, 2006)

While the authors refer to activity creating context, Luckin (2008) describes 'learner-generated contexts' consisting of learners using portable digital technologies. Also grounded in Vygotskian social constructivism, she regards the development of the individual in the internalisation of interactions with the environment, set within a social context. Similarly, a central concern of Sharples, et al (2007:2) is 'how people artfully engage with their surroundings to create impromptu sites of learning,' utilising social as well as environmental resources.

'Personalisation' in mobile learning research usually refers to a device's or application's awareness of, and adaptation to, an individual user's interests and preferences (e.g., Kinshuk, 2009). This does not usually include the whole of an individual's lived experience, but some technologists such as Gemmell, et al (2005) have sought to capture this complete lived experience using technology. They admit, however, that large amounts of largely unstructured data prove impractical for an individual to try and catalogue. But this is exactly the type of problem which trails, as described by Peterson and Levene (2003), address, by providing a structure for selective 'experience recording' of activity in context, as well as reflection and editing of that experience, targeted at meaning making. However, neither Peterson and Levene (2003) nor other researchers of trails (Choquet, et al 2008;

Papadogkonas, Roussos and Levene (2008, 2006); Schoonenboom, et al, 2007; Schoonenboom, et al, 2004; Keenoy, et al, 2004) have provided a model of context for meaning making in museums.

Museums can be seen as historic constructs in Cole's (1996) definition, reflecting the cultural and historical conditions of their establishment and development. They were built to collect, preserve and display the authentic, but often through artifice and decontextualisation, as discussed in Chapter 2. Context is thus a complex concept with regard to museums. The introduction of portable digital technologies complicates this relationship further, if they can be said to create their own contexts, as discussed above. This thesis therefore investigates the idea that a concept such as a trail is a suitable means of connecting artefact interpretations together by linking them to a visitor-generated construction — in effect using the portable digital device as a tool to help re-contextualise artefacts in the visitor's personal or social context, while simultaneously helping to reveal artefacts' original contexts. In Kahr-Højland's (2007) conceptualisation, portable digital devices are thus treated as 're-mediators.' Falk and Dierking's (2000) Contextual Model, discussed in the next section, provides a rich model of the physical, social and personal contexts of museum meaning making, analogous to technologists' notions of location awareness, social networks, and personalisation.

4.4 The Contextual Model of Learning, a theoretical perspective on museum meaning making

According to Crotty (2003), a theoretical perspective consists of philosophical assumptions about reality. In the past two decades or so, the most dominant approach to how people make meanings in, and from, museums has been Falk and Dierking's (2000, 1991) Contextual Model of Learning. The model views meaning making as both process and product, resulting from the integration, over time, of three overlapping contexts of the visitor: personal, physical, and sociocultural. Time is an important dimension, since these contexts change over time, and the theory is meant to cover meaning making processes which stretch to before and after museum visits. The latest version of the model (Falk and Dierking, 2008) is depicted in Figure 4.2.

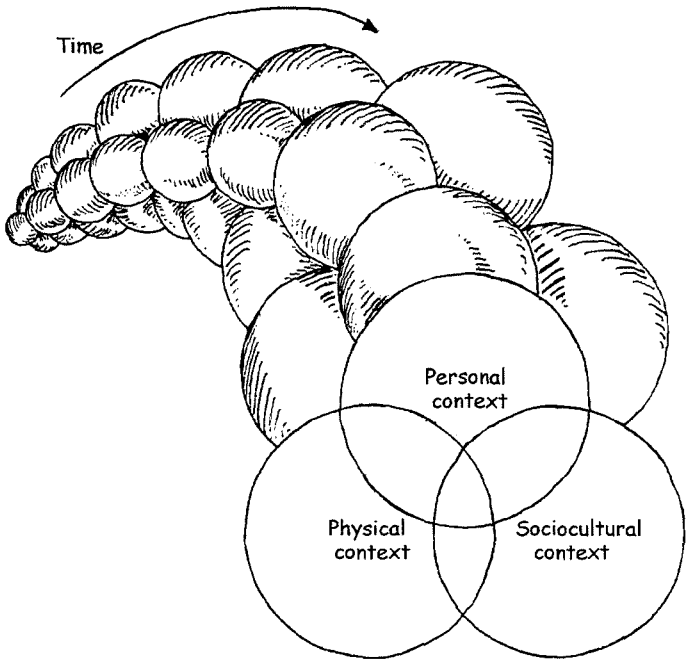


Figure 4.2 Contextual Model of learning in museums, from Falk and Dierking (2008)

4.4.1 Personal context

According to Falk and Dierking (2000), the personal context encompasses an individual's prior knowledge, interests and beliefs, as well as motivations and expectations, choice and control. This personal context — focused on how a visit contributes to a visitor's existing knowledge instead of on new information learned — is, according to Falk and Dierking (2008) the single most important factor in visitor meaning-making. This situates the Contextual Model firmly in a constructivist epistemology, drawn primarily from the work of Piaget (1969) who advocated studying the process of knowledge formation rather than the end product. The Contextual Model focuses on 'free-choice' learning — that which is intrinsically motivated — in alignment with Piaget's emphasis on the role of free play in meaning making.

But as Falk and Dierking (2000) point out, while research on prior knowledge and the personal construction of meaning has dominated research labs and formal education, it has been virtually absent in museum research until recently. Just how 'active' museum visitors are in making meanings is difficult to measure, since most visitors, particularly in art museums, outwardly adopt a universal, passive posture in relation to exhibited artefacts. The Communication Design Team of the Royal

Ontario Museum (1999), for example, equates perception with behaviour among visitors, for whom seeing equals experiencing. The very word 'visitor' connotes passivity, as someone who visits a collection owned by the museum, then goes away. But as McLean and Pollock (2007) observe, a better alternative term has not been widely accepted.

4.4.2 Physical context

In keeping with the constructivist epistemology, the Contextual Model situates meaning making 'in dialogue with the physical environment,' according to Falk and Dierking (2008:22). This is supported by Czikszentmihalyi (1990), who identifies museums as optimal environments for self-motivated meaning making. Falk and Dierking therefore believe that non-linear museums or exhibitions are more suited to 'personalised' meaning making, because they offer more visitor choice and control (Falk and Dierking, 2000:182). (Personalisation was discussed in the previous section from a technical perspective, and is explored further in the studies in this thesis.) That full bodily movement affects the ways visitors make meanings is supported by Hooper-Greenhill (2007:4); this also links to a constructionist epistemology, as Papert (1980) for example, emphasises embodied learning.

Movement is most obviously related to orientation and wayfinding, and museums enable visitors to freely select (within limits) what and where to explore. On the other hand, successful meaning making depends on successful orientation of the museum space (Evans, 1995; Hayward and Brydon-Miller, 1984; Kubota and Olstad, 1991). Museums support this by providing maps, pre-authored themed trails and 'advance organisers' which provide a big-picture conceptual overview of a museum or exhibition. However, there is evidence that visitors have trouble interpreting top-down maps and floor plans (Hegley, 2007). Visitors tend to identify exhibits spatially ('that one over there') rather than by name or description (Fleck et al, 2002) and no matter how linear an exhibition, visitors' navigation is subject to the unpredictability of other visitors; for example visitors tend to avoid exhibits with other visitors near them (Semper, 1998:121). Trails, as described in the previous chapter, are intended to link exhibits that visitors choose to visit, rather than prescribed ones.

According to Sharples, the physical context is linked to time, as well as the visitor's personal context:

> For example, a visitor to an art gallery stands in front of a painting. She has arrived at a current understanding of the painting from the path she has taken through the gallery — taking in the ambience, stopping at other paintings, reading the guidebook — and also from

a lifetime of creating and interpreting works of art starting with childhood drawings. (Sharples, 2005)

Other physical context factors affecting visitors' meaning making include lighting, crowds, colours and sounds (Evans, 1995; Hedges, 1995; Ogden, et al, 1993; Coe, 1985). Perhaps most obviously, given the focus in visitor studies on optimising the visitor experience, ample research links meaning making to the sequencing, placement, content of and attention to educational materials in the museum (Paris, 2002; Dierking and Falk, 1998; Serrell, 1998; Serrell, 1996; Bitgood and Patterson, 1995; Bitgood et al, 1994; Falk, 1993).

The museum's physical context is also changed, not least, by the people who inhabit it — their numbers, noise level, actions and interactions. Thus the physical context also overlaps with what Falk and Dierking (2000) term the sociocultural context.

4.4.3 Sociocultural context

Falk and Dierking (2000) also situate meaning making in what Crotty (2003) terms social constructionism, in recognising that museum visitors are culturally conditioned. Here they also draw from Vygotsky (1978), discussed further in Section 4.5. The sociocultural context includes visitor interactions within, and outside, their own social group, as discussed in Chapter 2. According to Stainton (2002), 'Seeing a museum through a sociocultural lens considers the visitors as people who are in conversation, literally and figuratively, with the artwork on display and with the curatorial intent' (Stainton, 2002: 214),

Falk and Dierking (2008) provide evidence that all three of the contexts described above have 'a significant, though often small, correlation with change in meaning-making,' though the particular mix of influences differs with museum and visitor type and topic (Falk and Dierking, 2008:24). The Contextual Model suggests that portable digital devices can help situate museum meaning making in the broader contexts of visitors' lives, by making links not just to, and within, the physical context of the museum, but also to visitors' personal, social and cultural contexts, specifically through personalisation, context crossing, and with multiple media (Ibid., 27-8).

4.4.4 Limitations of the Contextual Model as a theoretical perspective

Pierroux (2006a) studied teenage students in an art gallery, who used mobile phones to update a wiki (an editable Web page) while in the gallery, which was then revised by the students back in the classroom. Thus her study transcended the physical confines of the gallery, and this informes her critique of Falk and Dierking's focus on discrete contexts. Viewing the personal, physical and sociocultural as separate contexts, Pierroux contends, perpetuates a focus on the assimilation of information by an individual visitor, treating context as an external, quantifiable variable. She proposes that meaning making does not happen *in* context; rather, context is an integral part of meaning making. Social interaction is generally regarded as significant in many contemporary approaches, she says, but how or why often goes unasked and is under-theorised.

Pierroux (2006b) also contends that the Contextual Model tends to freeze time at critical junctures, instead of looking at activity which has a history and which develops over time. A later version of the Contextual Model (Falk and Dierking, 2008), which was depicted in Figure 1, includes a time dimension, and shows all three contextual spheres moving together through time; the use of spheres instead of, for example, continuous cylinders, presumably depicts instances when the three contexts do and do not overlap, though this is not clear. According to Kaptelinin (2008), the separation of context into three separate spheres permits a 'detailed understanding of the micro-dynamics of visitors' interactions in museums, which together are intended to depict the complexity of museum meaning-making,' but he contends that Falk and Dierking do not include a clear strategy for synthesising them into a whole (Kaptelinin, 2008:6).

Kaptelinin (2008) also believes that while the Contextual Model richly describes the museum meaning making environment, it is not adequately suited to the design and analysis of digital technologies, due to its focus on large-scale contexts instead of 'the micro-dynamics of visitor's interactions in museums' (Kaptlinin, 2008:7). The Contextual Model, for example, does not account for the concept of mediation, either by technological tools, interpretive materials, curators or other individuals; tools and interpretation are instead included in the physical context along with artefacts themselves, and other people are included in the sociocultural context. The Contextual Model also does not explicitly regard visitors' goals or motives for visiting, though these could be said to be contained within the personal context.

The alternative proposed by both Kaptelinin (2008) and Pierroux (2006b) is based on activity theory, which is detailed next. I propose, in the succeeding section, that the two approaches can be complementary, and develop a conceptual model which aims to reconcile them for the analysis of visitor-constructed trails.

4.5 Activity theory, and its methodological relevance for museum meaning making

In activity theory (AT) as developed by Vygotsky (1978) and others, activities as a unit of analysis are seen in a rich social matrix of people, artifacts and other resources. Grounded in a social constructivist epistemology, AT foregrounds the social context of meaning making without neglecting the role of the individual, regarding the boundary between individual and collective as overlapping. For example in this view, competencies such as reading and writing begin as social functions and become internalised; conversely, they are externalised when a breakdown occurs, when knowledge is to be shared, or when activities are socially distributed.

AT has become widely used in learning research (e.g., Engeström, 1987), including mobile learning research (Taylor et al, 2006); and in human-computer interaction design (e.g., Kaptelinin and Nardi, 2006; Bannon, 1997). It has recently been utilised in museum research, particularly with regard to technological mediation (Kaptelinin, 2008; Pierroux et al, 2007; Pierroux, 2006a; Jaén et al, 2005; Gay and Hembrooke, 2004; Gottlieb et al, 2004). Kaptelinin and Nardi (2006:151) use curation as an example of an ideal activity — though not in a museum context but in a biotechnology company in which scientists 'curate' a database of genetic information in order to develop medicines. A database which is annotated with high-quality information is described as being 'well curated,' for a well-organised presentation leads to experimental results and scientific literature. The process of curation, as described in Chapter 2, is nothing more than selecting a subset of something to present to others, hiding or revealing data according to one's motives. This is what museum curators do, and in the context of this thesis, it is what visitors do in the activity of trail construction.

The particular interpretation of AT used in this thesis is drawn primarily from Kaptelinin and Nardi (2006), who in turn derive it from Leont'ev (1978), and shape it into a particular methodology for studying technologically-mediated activities. This differs from the interpretation by Engeström (1987) which is more widely used in education research. For example, Kaptelinin and Nardi consider activities to be both individual and collective, while Engeström maintains that they can only be

collective; this is explored in the studies in this thesis, within the activity of trail construction. Kaptelinin and Nardi's approach also differs from that of Sharples, et al (2007), who differentiate between technological and semiotic layers of tool-mediated activity; Kaptelinin and Nardi regard these layers as inseparable. Kaptelinin, et al (1999) describe five basic principles of AT which are relevant for investigating trails: 'object-orientedness,' the hierarchical structure of activity, internalisation and externalization, the concept of mediation, and the historical development of activity. Each of these is discussed in further detail below.

4.5.1 Object-orientedness in activity theory

By focusing on meaningful, goal-directed, 'object-oriented' actions, AT views the object of activity as an analytical tool revealing meaning and its development over time. As discussed in Chapter 2, to avoid confusion in this thesis I use the the term 'artefact' to differentiate museum objects from objects of study in a hermeneutic sense, since in some cases a museum artefact may itself be an object of study, while in others it may mediate study of another topic such as a historical event or scientific concept; the concept of mediation is detailed in Section 4.5.5.

Methodologically, AT is oriented toward explicating the goals and objects of activity. By contrast, Falk and Dierking's (2000) definition of 'free-choice learning' is aimed at casual museum visitors, and thus lacks any notion of explicit goal orientation. Yet, looking closely, goals associated with museum-going can be distinguished: as discussed in Chapter 2, people consciously go for enjoyment, for a 'learning experience' (however hazily defined) which is unforced and self-directed, and for socialisation. More specifically, visitors go to particular exhibitions to encounter particular artworks or artists, and may have more explicit learning goals in science and history museums. Formal school visits usually have explicit goals. Looking at the outcomes of even casual museum visits, narratives emerge as a frequent product, as discussed in Chapter 3, for example in the stories told to friends and family about museum visits. Set within the broader cultural context, such narratives can relate to rituals of socialisation and initiation into particular specialist communities, as described by McClellan (2003b).

Trail construction can be seen as a means of imposing an explicit goal onto a museum visit, providing a scope and product of visitors' activity, and this is explored in the studies in this thesis. Traditional, paper-based museum trails provide a bounded structure, but may or may not have an explicit goal or product; trails as discussed in the previous chapter, by contrast, are framed as as a concrete product of

a visit to be shared or discussed, making explicit both the physical activity and articulation of that activity within a conceptual (generally narrative) structure.

4.5.2 Hierarchical structure of activity in activity theory

In AT, activities are the 'minimal meaningful context' for analysing technology in use (Kuuti, 1991). AT subdivides activities into an 'object hierarchy' of activities, actions and operations (Leont'ev, 1978). Following the goal orientation discussed above, activities are seen to be driven by motives, which may be conscious or unconscious. Actions are carried out to fulfill motives, and have conscious goals. Operations are subconscious, adjusting actions to situational changes. Conscious actions can become subconscious operations when knowledge is internalised, and operations can, in turn, become conscious actions when conditions impede their completion. For example, as discussed in Chapter 2, museum staff usually spend time familiarising visitors with portable digital technologies which are loaned out, whereas visitors may have internalised the means of operating their own devices.

The hierarchical structure of activities has specific methodological implications. Trail construction can be seen as a discrete activity, with particular actions and operations, set within the broader activity of museum visiting. González and Nardi (2005) add to the object hierarchy a level of 'engagements' in between activities and actions, defined as chains of thematically-connected actions within goal-oriented activities; trail construction could be viewed as such an engagement. Analysing trail construction activity, moving up and down the hierarchy as needed to examine actions, operations, goals and motives, is a method used in this thesis, as described further in the next chapter. Kaptelinin and Nardi (2006:151) regard the activity of curating as a 'high quality' object of activity, as discussed previously. A trail may be seen as a simple form of curation through the selective placement of individual artefacts into a coherent narrative.

4.5.3 Internalisation/externalisation in activity theory

Viewed within AT, competencies such as learning to use a device interface begin as social functions and become internalised; as discussed, they are externalised when a breakdown occurs, when knowledge is to be shared, or when activities are socially distributed. Thus, mental phenomena cannot be understood in isolation, and the social world is therefore not regarded as an external reality which

is simply internalised via sensory inputs by an individual; rather, meaning making is seen as an inherently social process (Kaptelinin, et al, 1999).

Methodologically, AT looks at and for processes of internalisation and externalisation. A relevant avenue of inquiry regarding trails, therefore, is the extent to which trail construction may be internalised by a visitor as a form of self-regulation, and externalised during collaboration. A place to look for evidence of such internalisation and externalisation might be in visitors' dialogue and actions, specifically the extent and frequency of explicit references to trails during trail construction.

4.5.4 Historical development of activity

Methodologically, where the Contextual Model looks at 'snapshots' of meaning making in the overlap of the three contextual spheres, AT views meaning making activity as a process of continuous development over time; indeed, monitoring developmental changes is a central methodological consideration in AT.

Thus, while the Contextual Model might be useful for identifying aspects of the various contexts with regard to meaning making, AT could be used to study the development of trail construction activity over time, helping to focus attention on visitors' objects of attention, their activity, and the tools (technological and otherwise) which mediate the activity. Such mediation is discussed next.

4.5.5 The concept of mediation in activity theory

As discussed in Chapter 2, studies of technology in museums have tended to focus on the interactions between the visitor(s) and the technology itself, not on the relationship between visitor and museum, and how technology can mediate that relationship (Morrissey and Worts, 1998). AT regards tools as mediating human actions and interactions in the world, differentiating physical from cognitive tools, and analysing an entire 'activity system' which includes people and the context of use. As regards trails, if a portable digital device is considered a physical tool, then a trail could be considered a cognitive tool; a trail representation could then be considered an externalisation of thinking. Säljö (1996) regards meaning making as directly related to the appropriation and use of tools. Therefore, designing for appropriation requires that both the context and the motivation of tool use must be made relevant to museum visitors, according to Gay and Hembrooke (2004).

This relationship between tools and users differs from that used in 'actor-network theory,' as developed by Latour (2005) and others. Actor-network theory views material and semiotic resources in a network of relationships in which both human actors and things are accorded agency, and treated as a single entity, according to Kaptelinin and Nardi (2006:202). For the purpose of this thesis, such an approach does not apply to a museum, in which individual visitors are simultaneously crucial to a museum's definition, yet visit museums so infrequently that they cannot be considered part of a museum 'network.' Additionally, to accord museum artefacts with agency masks their potential dual role as either objects of study or mediators of the study of another topic, as discussed below. Actor-network theory contains a notion of 'mediators,' but this refers to things and concepts which mediate large-scale social processes, not tools which mediate intentional, specific activities oriented toward goals and products, as in AT. Actor-network theory is thus oriented toward sociological study of widespread phenomena, whereas AT is focused on the dynamics of how people make meanings in tool-mediated activity.

Double mediation and 'activity contexts'

Meaning making, as conceptualised by activity theory, occurs within cultural-historical contexts, according to Cole (1996), which in museums can include the cultural-historical characteristics of artefacts. While museums can be regarded as the physical context of meaning making, the artefacts they collect and display have their own original contexts of creation and use, and are thus decontextualised while simultaneously re-contextualised in a new setting — usually the only physical setting in which visitors encounter such artefacts. Pierroux, et al (2007) therefore discuss the 'double mediation' of technology-enhanced meaning making in museums, in which visitors' meaning making can be mediated by museum artefacts as well as by technological tools. The authors propose that portable digital technologies can serve to bridge the 'activity contexts' of visitors with those of museum artefacts, when used in specific activities in the museum's physical context. This idea was further developed by Kaptelinin (2008):

> Museum artefacts are crystallized outcomes, by-products, or tools of activities: be it objects of art, material witnesses of historical events, or simply things from the past. The objects are there for visitors to see, but the activity contexts they represent, by necessity (and sometimes also by design) cannot be perceived directly. (Kaptelinin, 2008:9-10)

Portable digital technologies could therefore be employed as mediating tools to help visitors engage attentively, cognitively and emotionally with museum artefacts through appropriation of the artefacts' narratives. According to Kaptelinin (2008), this can be accomplished through specific processes of 'downwards contextualisation' — for example, coming to an understanding of how an artefact was used; or 'upwards contextualisation' — for example, connecting an artefact with the visitor's interests or goals.

4.5.6 Limitations of activity theory as a methodology

Crotty (2003) defines methodology as a strategy and process underlying specific methods. As discussed in this section, AT has mostly been treated methodologically as an analytical tool, for example for explicating the goals and objects of activity; focusing on the hierarchical structure of activity by (for example, zooming in and out, or moving up and down the object hierarchy); tracking meaning making processes over time (through for example processes of internalisation and externalisation); and particularly for analysing tool mediation of activities in context.

Papadimitriou, et al (2007), for example, used AT to analyse a visit by students to a museum, who used PDAs to collect data in order to attain a particular goal. At a micro level, AT helped the authors focus on how low-level operations inform higher-level actions, by defining behaviour types such as 'reading information' and 'negotiating the next action'. These were coded from video data and grouped into actions such as 'support,' 'data search' and 'reasoning.' As a result, the authors were able to identify patterns in the students' activity: for example, students tended to ask for more support during the second (reasoning) phase than the first (collecting) phase. More broadly, AT enabled the authors to look not only at students and devices but at the role of facilitators. The authors concluded that AT seemed ideal as a conceptual tool in the context of a technology-enhanced museum visit by broadening the focus beyond outcomes, to tools and context. However, they identified limitations in the use of their own tools for dialogue capture and analysis.

While AT may be ideal for investigating tool mediation, it lacks the rich description of the museum meaning making context in the Contextual Model. The model of activity contexts developed by Kaptelinin (2008), for example, refers to a single museum artefact, thus neglecting surrounding artefacts in the museum, as well as other aspects of the physical museum context which are vital for museum meaning making generally and trail construction specifically, as discussed in Chapter 2.

According to Ackerman (2001), despite looking at processes of externalisation as well as internalisation, AT, being rooted in Marxist psychology, is generally focused on moving from the physical or external to the mental or internal, centering on an individual subject, its idealised method being the 'formalised experiment' according to Leont'ev (1978). Kaptelinin (2008:14) admits that his own model is too linear, neglecting for example Leont'ev's (1978) hierarchy of activities, actions and operations, which were described in Section 4.5.2. The 'mediating means' in Kaptelinin's model could be said to include museum interpretation and other aspects of the physical context, but he frames the mediator primarily as a technological tool. The broader cultural context is implicitly embedded in activity theory, particularly in the notion of historical development, discussed in Section 4.5.4, but this is not explicit in Kaptelinin's 'time' trajectory.

For the specific study of trail construction, neither AT nor the Contextual Model accounts for explicit construction processes in a museum context, specifically the linking of individual artefacts to construct a broader understanding of a topic. Thus, the trails concept could contribute not only to structuring visitors' activity in museums, but also to a conceptual structure for understanding visitors' activity, as well as providing a concrete product for focusing visitors' meaning making. In other words, trails could contribute to both practice and theory with regard to museum meaning making. In order to do so, a conceptual model for trail construction needs to be developed, which draws from the theoretical basis of the Contextual Model, and the analytical methodology of AT. Such a model is developed in the next section.

4.6 Development of a conceptual model for the design and analysis of trails: TrACE

As discussed in Section 4.1, I have roughly followed the approach of Crotty (2003), by detailing an epistemological grounding in constructivism, a theoretical perspective based on Falk and Dierking's (2000) Contextual Model, and a methodology drawn from activity theory. While the theory and methodology discussed are both firmly grounded in constructivist epistemology, I have also identified constructionism, as defined by Papert (1987), as a relevant pedagogical approach. All of these approaches have methodological implications, which are detailed in the next chapter. Each addresses different aspects of trail construction, and so here a conceptual model is developed to lend coherence, and act as a focal point for analysis.

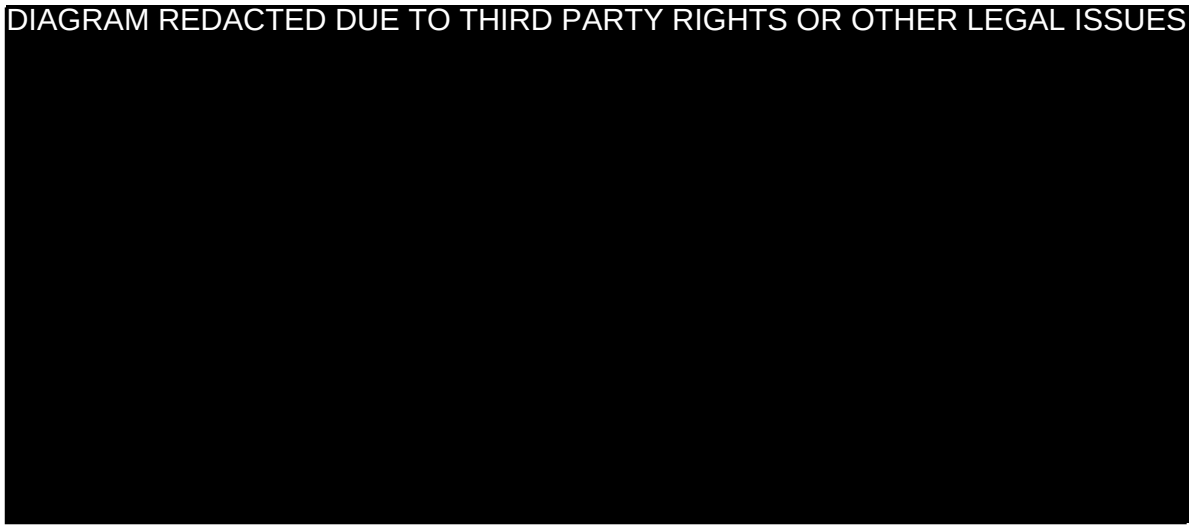
One way of reconciling the approaches discussed in this chapter is to first place a single visitor in context; more specifically, following Luckin (2008), to regard context as learner-centred, by situating Falk and Dierking's spheres of context as centred in concentric rings around the visitor, as shown in Figure 4.3.

Figure 4.3 My adaptation of Falk and Dierking's (2000) spheres of context as visitor-centred concentric rings.

This conceptualises the spheres of context as part of a visitor's experience of the museum. An individual with personal interests, experience and beliefs is also part of a social context. (Hereafter I generally use the term 'social context' instead of 'sociocultural context'; this distinction is explored in depth in each of the studies.) Finally, the visitor is situated in the physical space of the museum, which is itself situated in a particular physical and cultural setting.

It must be recognised that, as in the Contextual Model, the boundaries are fluid — for example the social context can extend well outside the physical; it is merely placed inside to emphasise that trail construction activity takes place solely within the physical context of the museum. However, the physical context does not necessarily equate with the walls of the museum: it could refer to a single gallery for example, and a museum may also contain other kinds of physical contexts such as the shop or café — each of which links to particular social rituals and conventions, and personal experiences. Sharples, et al (2007), do not regard context as a fixed shell around a learner, but as continuously reshaped through interactions and dialogue. While my model depicts a single visitor surrounded by shells of context, when the model is put into motion as shown below, the overall contexts of activity continually shift as the visitor interacts with other visitors, artefacts, places, tools and resouces.

Cole (1996) provides a precedent for regarding individuals within concentric circles of context. Indeed, the social context depicted in Figure 4.3 could be regarded roughly as 'that which weaves us together' and the physical context as 'that which surrounds us,' while recognising that Cole's conceptualisation can be broadly characterised as sociocultural. The three levels of context depicted in Figure 4.3 also correspond roughly to Vavoula's (2007) levels for evaluating mobile learning activities, namely micro (personal), meso (physical), and macro (social) — bearing in mind that the physical and social are reversed in this case, and repeating the above disclaimer about fluid boundaries. Placing the physical context in the outermost circle shows how multiple visitors may share the same physical context, but unless they are interacting or are part of the same visiting group, may not share the same social context, as shown in Figure 4.4.



4.6.1 Artefact contexts

Kaptelinin (2008) and Pierroux, et al (2007) argue that making meaning from museum artefacts requires bridging the 'activity contexts' of visitor and artefacts, as shown in Figure 4.5. This entails linking an artefact with the visitor's personal context. When museum artefacts are regarded as objects of study in themselves, rather than tools or mediators for some other topic, then this definition of an artefact's context could include its aesthetic properties; thus unlike the model of Kaptelinin (2008), this conceptual model could apply to art museums as well as history or science museums.

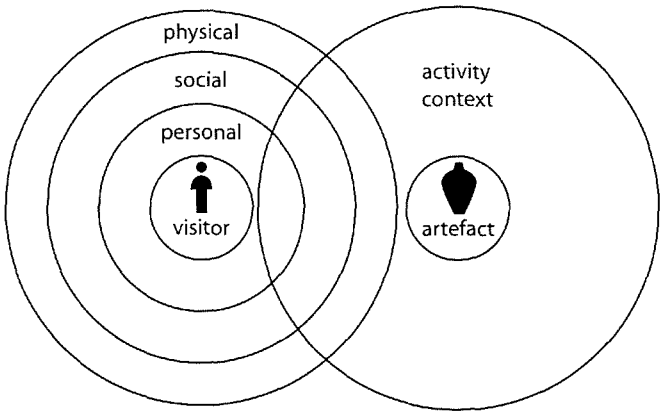


Figure 4.5 Visitor shown bridging an artefact's activity context.

4.6.2 Putting the model in motion

Trails are constructed from visitors' encounters with multiple artefacts in the museum, over time. Adding a time dimension to the conceptual model, a visitor's encounter with multiple artefacts in an exhibition can be depicted as in Figure 4.6, as the visitor engages with some artefacts' contexts and not others. The line connecting artefact encounters represents activity in the form of a trail, and encounters with each artefact can thus be analysed individually or collectively.

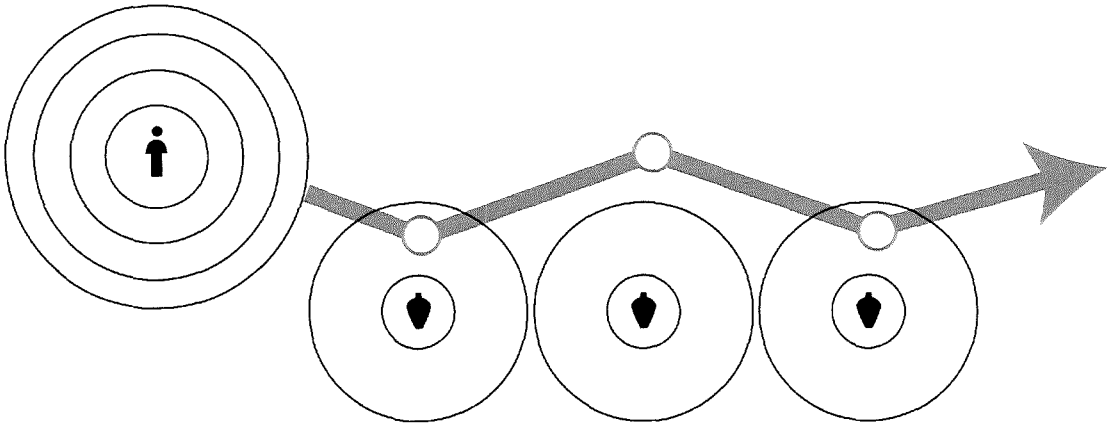


Figure 4.6 Visitor encountering multiple artefacts, engaging with some artefact activity contexts but not others, at individual trail stops.

In a fundamental sense, the visit thus results in a linear trail of artefacts encountered. Viewed this way, a trail is necessarily a simplified representation of a visitor's path; individual artefacts may be revisited, compared with others, or encountered in multiples. But this nonetheless serves as a starting point for constructing a narrative account or dialogue about a museum visit.

4.6.3 Tool mediation in visitor-artefact encounters

According to Dourish (2004), context is constantly changing in interactions between subject (visitor), object (artefact) and tool. As discussed in Section 4.5.5, Pierroux, et al (2007) propose that technological tools can be used to help bridge visitors' and artefacts' contexts. In the successive model developed by Kaptelinin (2008), the mediating tool is regarded as a separate entity from both visitor and artefact. By contrast, Falk and Dierking (2008) consider technological tools as part of the physical context of the museum. However, a portable digital device is not fixed in the museum but is carried (and may be owned) by the visitor. Since this study focuses on portable digital technologies, I place them as linked to the visitor's personal context, as in Figure 4.7.

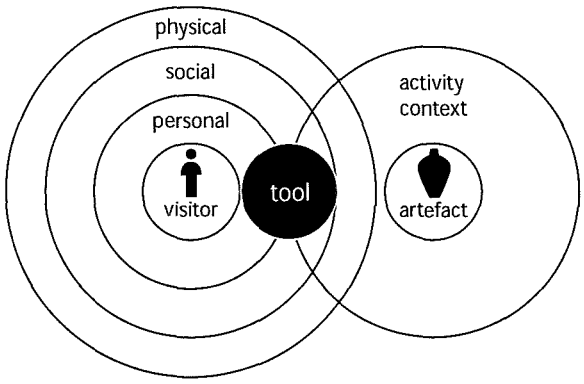


Figure 4.7 Tool shown mediating visitor and artefact contexts.

A visitor's mediated encounter with each artefact can thus be analysed using this model, as shown in Figure 4.8. This model serves as a starting point, a first iteration for analysis and is utilised in the first study, which is described in Chapter 6. Hereafter I refer to it as the TrACE model, for Trails of Activity Context Encounters.

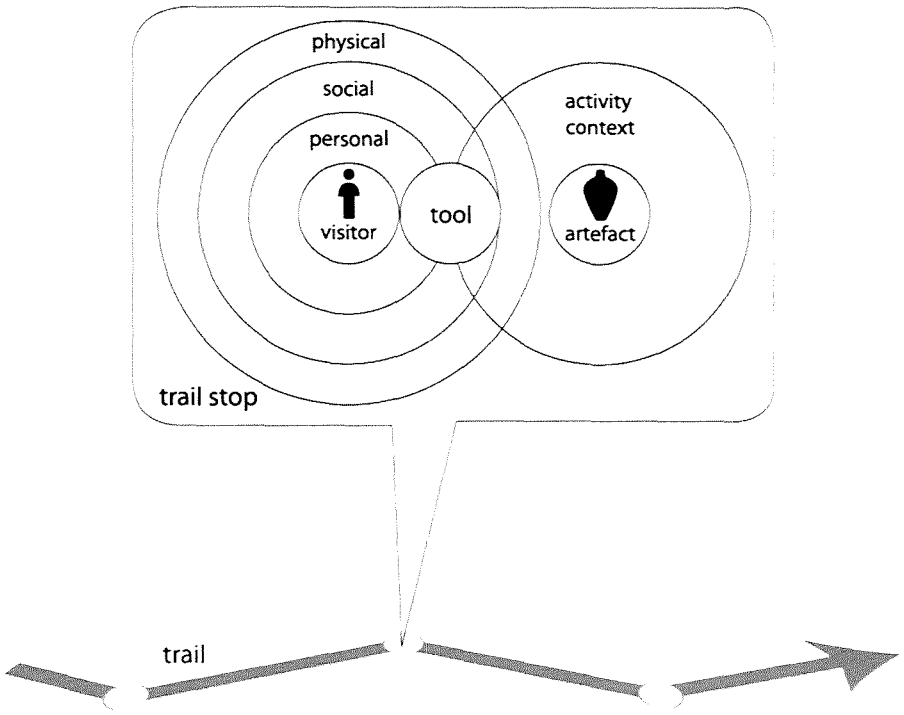


Figure 4.8 Initial TrACE conceptual model for trail analysis, depicting a visitor's mediated encounter with one artefact in a trail.

4.7 Conclusion

This chapter outlined a framework based roughly on the approach of Crotty (2003), consisting of an epistemological grounding in constructivism and constructionism, a theoretical perspective specific to meaning making in museums, and a methodology drawn from activity theory. I differentiated between constructivism, as an individual process of meaning making between subject and object, set in a social and cultural context; and constructionism as defined by Papert as a pedagogy oriented to building meaningful products, embodied and situated in local contexts. Context was discussed in the technological literature of mobile learning, in terms of personalisation, social networking and location awareness. These were shown to relate to Falk and Dierking's (2000) personal, sociocultural and physical contexts, and the authors' Contextual Model is used as a theoretical perspective in this thesis. Activity theory was detailed, with specific attention to methodological considerations, and a conceptual model was developed for the analysis of visitor-constructed trails in museums.

The TrACE model is aimed at identifying and analysing the key aspects of visitors' encounters with artefacts during the process of trail construction, as mediated by technological tools, and in context(s). How technology mediates and bridges contexts in turn affects meaning making. The specific means of investigating trail construction using this model are detailed in the next chapter, with research questions arising from the preceding literature reviews and theoretical discussion; and methods are detailed for analysing trails in different museum contexts and with different types of visitors. Two analytical tools are used for data analysis in the first study, one based on the Contextual Model, which is meant to analyse the three spheres of context described above; the other is grounded in activity theory and is intended to analyse activity and tool mediation between visitor and artefact in the model. These analytical tools inform the further development of the TrACE model.

Chapter 5
Research design

In this chapter a research design for the design and analysis of trail construction activity in museums is detailed, which is enacted in a series of studies described in the succeeding chapters. Specific methods are derived from the conceptual model described in the previous chapter, which in turn was informed by the methodology of activity theory, and the Contextual Model of Falk and Dierking (2000) as a theoretical perspective. The research design developed in this chapter supports the aim of the thesis, to explore how people make meanings in and from museums by constructing trails with digital technologies, by focusing on the design and analysis of trail construction activity as a process, investigating visitor meaning making with tools in the museum context.

First, relevant methodological issues related to museums, portable digital technologies, activity theory, and trails research are reviewed. Next, specific research questions are formulated and discussed. This is followed by a detailed plan for investigating these questions, concluding with a presentation of two specific analytical tools to be used as a starting point for analysis in the first study.

5.1 Methodological issues

This section reviews relevant methodological issues related to museums, portable digital technologies, the Contextual Model, activity theory, constructionism, and trails. Each of these aspects raises particular challenges, but there are also complementary aspects. Each, for example, approaches the concept of context in a different way, with technology and trails research each contributing

specific methods for using portable digital technologies in context, and with activity theory and the Contextual Model together providing broad and deep methodologies for studying context.

5.1.1 Methodological issues related to museums

As discussed in Chapter 2, museums are complex places for meaning making, simultaneously 'semi-formal' (Kahr-Højland, 2007) with explicit educational missions; and 'free-choice' (Falk and Dierking, 2000), lacking in assessment or adherence to a single curriculum. Thus a variety of research methods have been employed to investigate meaning making in museums, the most common being the front end/formative/summative surveys common in 'visitor studies.' The field of visitor studies began early in the last century, with primarily quantitative methods — specifically tracking visitor time and paths through exhibitions. The goal was to create a kind of scientific approach to educational exhibits; hence it was focused on evaluating the content and design of the exhibits. It emphasised the classification of visitors and their behaviours into types, and often made claims about meaning making based on these methods, without any theoretical grounding or analytic concepts (Pierroux et al, 2007).

In the 1980s, the focus in visitor studies shifted away from exhibits and more to the visitors themselves, as museums began to employ more full-time educational staff, and it was accepted that no matter how well-designed an exhibition, visitors would still construct their own interpretations (Hooper-Greenhill, 2007:27). For example Serrell (1993) in a typical approach, timed visitors at exhibits as a measure of 'engagement.' An implicit assumption of such approaches is that engagement equates with learning; and only that which is measurable is worth learning (Pierroux, 2006b). Such research is normally done by museum staff and tends to be piecemeal, private and proprietary, and according to Hooper-Greenhill (2007:7), this has inhibited theory-building and research. Indeed, after more than a century of museum education efforts, there was still no clear understanding of how people make meanings in museums (Boodle, 1992).

Quantitative data are valuable to museums for obtaining or maintaining funding for educational programmes. The Museums, Libraries and Archives Council thus commissioned a systematic way to show evidence of the impact of learning from museums. The resulting scheme borrowed a concept directly from formal education — that of measurable 'learning outcomes,' and is similar to one used in the US, called Outcome-Based Evaluation (which is similarly tied to funding programmes). However, in order to cover all types of museums, galleries, libraries and archives, the resulting

'Generic Learning Outcomes' (GLOs) are necessarily broad, encompassing 'knowledge and understanding; skills; attitudes and values; activity, behaviour and progression; and enjoyment, inspiration and creativity' (Hooper-Greenhill, et al, 2003; Hooper-Greenhill, 2002).

Because of their breadth, the GLOs cannot be used to measure particular subject knowledge. More problematic however is the focus on measurable 'outcomes' of learning. According to Brown (2006), 'this stance appears to confuse set learning outcomes with actual learning experiences'. He contends that different learning environments afford different learning experiences by facilitating and inhibiting certain kinds of activity. Thus a methodology informed by activity theory, as discussed in the previous chapter, focuses more on the process, not product, of meaning making in context.

One reason for the lack of consensus on research methods is that museum visiting as a cultural practice and a specific activity tends to be passive and silent, particularly in art museums in which meaning making is equated with aesthetic engagement (McClellan, 2003b). If making meanings through interpretation is defined as 'the construction of internal representations by perceiving and cognitively processing external representations through selection, organization, and integration' (De Vries et al, 2008), then such internal representations must be made visible either during their construction or afterward through articulation, construction, or other means. Thus audio recording (e.g., Allen, 2002) and video recording (e.g., Gottlieb et al, 2004) have been useful for studying visitors in conversation and in action. Video recording for example, according to Plowman and Stephen (2008) is effective for capturing interactions between people, artefacts and the environment. Explicit construction methods such as writing (Watson, 2007; Leinhardt et al, 2002) also have been effective in externalising visitors' inner thought processes. Trail construction can be viewed as such a constructive activity. This leads to technological considerations, which are discussed next.

5.1.2 Methodological issues related to portable digital technologies

According to Kondor (2008), knowledge is best understood through mundane practice; therefore it is worth focusing on technologies which mediate such practice (Kondor, 2008:ix). Mobile learning research, for example, has focused on context-crossing (e.g., Wali et al, 2008) as well as the capture of relevant contextual information (e.g., Vavoula, 2007). With regard to museums, portable digital devices themselves can aid research by capturing aspects of the physical context such as navigational choices (e.g. Roussos et al, 2005), and visitor-selected digital versions of museum artefacts or

exhibits (e.g. Rudman et al, 2008; CETADL, 2006a, 2006b). They can capture social data such as visitor conversations (e.g. Allen, 2002) and the decisions and results of social activities (e.g., Byrne et al, 2008). And they can capture personal choices such as exhibits visited (e.g., Hsi, 2008) and interpretations (e.g., Puig et al, 2009). Log data and interaction histories can supplement such qualitative data with quantitative details, and the products of visitors' actions and interactions could provide evidence of reflection both in the museum context and afterwards.

Because of the portability of the technologies used in this thesis, tracing their use over time and space is important, and this again points to the utility of video recording, and indeed recording visitors' trails through museums. Activity theory has specifically been used to study technology use in the context of activities, and its methodological implications are discussed next.

5.1.3 Methodological issues related to activity theory

Activity theory (AT) has been used to study how people adopt and adapt tools, including portable digital technologies, through negotiation, appropriation and mastery of concepts, in dialectic or dialogic processes (Kaptelinin and Nardi, 2006). It suggests specific methods and tools which have been developed for studying technologies and contexts. As discussed in the previous chapter, activities are the unit of analysis in AT, viewed as a system with associated actions and operations, goals and motives. Being situated in social constructivism, AT regards activities within their larger cultural contexts, as they have been shaped historically and as they develop during their enactment. Technology can aid AT research by capturing either discrete or continuous aspects of articulation, dialogue and activity. For example, Gottlieb, et al (2004) used video recording to study teenagers' interactions in an art gallery in the form of gestures, interest and dialogue; and Papadimitriou, et al (2007) used video recording to code behaviour types corresponding to particular actions and operations defined using AT.

A typical methodology in AT is to identify relevant areas of interest (Kaptelinin et al, 1999), and move upward and/or downward in the hierarchical structure of activity (Kaptelinin, 2008). For example, the researcher can look for evidence of internalisation and externalisation of specific concepts, and for the self-regulation of meaning making processes. Specifically with regard to trails, this might include internalisation/externalisation of the trails concept generally, or of the specific trail under construction, as well as any theme, concept or narrative underpinning it, depending on the particular museum and/or topic under study.

Regarding tools, AT has the concept of mediation which is missing from Falk and Dierking's (2000) model. Furthermore, AT adds a new notion of the 'double mediation' of meaning making in museums through both tools and artefacts (Kaptelinin, 2008; Pierroux et al, 2007) which has not yet been investigated in an empirical study. The researcher might look for clues about tool mediation, or double mediation, in visitor actions and conversations about, and through, the mediating tools. Specifically, attention could be paid to what the tools and artefacts enable which would not otherwise be possible.

A split between mind and action is distinguishable in traditional visitor studies methodologies: pre- and post-tests, surveys, talk-aloud protocols, interviews and questionnaires seek to access unobservable mental activity. In contrast, social-historical approaches such as AT often utilise audio and video recording methods, and more explicitly constructive methodologies such as diaries or journals (Leinhardt et al, 2002), cameras and other recording devices. These approaches are not restricted to qualitative analysis; for example, Paris and Mercer (2002:426) count 'performance indicators' in visitors' behaviour such as asking or answering questions, reading text, and explaining.

As mentioned, Leinhardt, et al (2002) used visitor-constructed diaries which they analysed from the perspective of AT. Portable digital devices, with audio, video and image recording capabilities, could provide even richer external representations for analysis. Trails are intended to provide a guiding structure for such visitor-constructed narrative accounts, and methodological issues regarding trails are covered next.

5.1.4 Methodological issues related to trails

Since trails are a relatively new area of research, there is no consensus on methods for their study. Beazley (2007) relied primarily on observation and her own intuition and experience as a trained teacher, in studying trails that she authored for students. Reynolds (2007) and Cook, et al (2010) used the traditional visitor studies methods of front end/formative/summative research including observation, surveys, interviews with teachers and students, plus 'guided visits' combining observation and the talk-aloud protocol; of these, the guided visits and interviews provided the richest qualitative data about visitors' interpretations and the technology used (see Walker, 2008). Brown, et al (2005) and Roussos, et al (2005) evaluated technological features of trails, not meaning making, and as such, focus on observation of the technology in use, plus analysis of server log data. Similarly,

Schoonenboom, et al (2007, 2004); Heller, et al (2004); and Keenoy, et al (2004) primarily analyse log file data, being focused on online, not on-site, trails. The trails taxonomy devised by Schoonenboom, et al (2007, 2004) and refined by Choquet, et al (2008) is not used in this thesis, since it is aimed primarily at technology design, separating and classifying individual learning objects, trail types and environments for the purpose of designing a system for personalised and adaptive content delivery. Keenoy, et al (2004) however make reference to Taylor, et al (2006) in proposing the use of methods from activity theory in studying trails involving portable digital technologies.

While much of the previous work in trails has been technology-led, the technologies themselves hold promise for capturing data about visitors' actions, interactions, choices and preferences, context, captured data and outcomes. Specifically, a trail of visitor-captured data should provide rich quantitative data (time stamps, artefacts or locations visited, number of different media type captured) as well as qualitative data (interpretations, conversations, edited or 'curated' products) which could then be analysed using tools and methods derived from the Contextual Model and/or activity theory, to give a rich picture of visitors' goal-oriented and technology-mediated activity in the personal, physical and social contexts.

5.1.5 Summary of methodological issues

From the preceding discussion, several important methodological issues emerge. Traditional methods employed in museum visitor studies, such as surveys, fail to capture the rich context of a visit, especially when mediated by technology. Attempting to evaluate only outcomes ignores dynamic meaning making processes such as internalisation and externalisation which can occur as activity develops. The Contextual Model provides a rich theoretical picture of the museum context, but requires grounded methodological tools, which activity theory provides.

Activity theory, for example, avoids focusing solely on technology evaluation; it looks rather at the broader social and historical context of use, and video recording has proven a particularly valuable method for capturing activity and context for analysis. Activity theory gives emphasis to qualitative data generally. According to Miles and Huberman (1994:1), qualitative data provide 'rich descriptions and explanations of processes in identifiable contexts' as well as insight into the chronological flow and consequences of actions; thus 'they help researchers to get beyond initial conceptions and to generate or revise conceptual frameworks' by helping extract abstract

explanations from concrete incidents or stories. This emphasis on process, context, actions and consequences is embedded in activity theory, as described in the preceding chapter. In particular, ethnographic methods are favoured (Kaptelinin et al, 1999).

Portable digital technologies raise special challenges, but also bring opportunities to add data to the rich picture of context and meaning making, specifically the capture by visitors of images, audio and text data, as well as log data automatically generated from use of the technology. In this thesis, the use of such tools is directed toward building narrative-focused products; the conversations and actions undertaken during the trail construction process are also analysed.

Trails can provide a way to structure not only visitor meaning making, but also visitor-captured data and context into a coherent narrative account of a visit for research purposes. Following Cook, et al (2010), observation and interviews can supplement visitor-captured data. According to Robson (2002:310), observation allows directness and can complement other techniques. His dimensions of descriptive observation (Ibid., 320) align with activity theory, and include descriptions of the setting, actors, activities, objects (in his case the physical context), acts, events, time, goals, and participants' feelings.

Thus the methodological approach used in this thesis draws primarily from activity theory, but is also informed by the Contextual Model of Falk and Dierking (2000) which provides a theoretical grounding, in order to counter technological determinism with attention to context, activity and dialogue. The next section frames the specific research questions relevant to studying visitor-constructed trails in museums.

5.2 Research questions

Investigating visitor construction of trails in museums clearly requires engaging visitors in trail construction activities using technologies in museum settings. This is accomplished in this thesis in three studies, which are grounded in the theory of contextualised meaning making, and analysed with regard to activity, dialogue, context, mediation, and development. The following research questions are derived from the literature review on museums, technology and trails, as well as the theoretical framework and TrACE model detailed in the previous chapter. The methodologies used for investigating each question are discussed.

Research Question 1: (How) can trails be used to support meaning making in museums?

This thesis derives primarily from the proposition by Peterson and Levene (2003) that recording a museum visitor's experience in the form of a trail can benefit meaning making. While some 'experience recording' technologies have been developed and tested, and some digitally-augmented, trail-like activities have been implemented in museums, as discussed in Chapter 3, emergent trails of this type have not been the subject of thorough and systematic empirical research. As noted also in Chapter 3, trails created for visitors by museum curators or educators have long existed, and have been the subject of some research. However, visitor-constructed trails have not previously been researched. A starting point, therefore, is to investigate whether trail construction can offer museum visitors support for meaning making with regard to artefacts and the subject knowledge and contexts connected with them; and if so, in what ways.

This is necessarily a broad initial question intended to illuminate areas of further focus. Its breadth implies that different kinds of trails should be investigated, with different types of visitors, in different settings. Thus, each study is different in terms of visitor type, setting, and topic, in order to investigate trails as an activity, not as a solely technological intervention.

The epistemological grounding in social constructivism, discussed in the previous chapter, regards visitor interpretations to be coloured by any additional information or guidance provided by the museum, including the arrangement of artefacts, interpretive materials, and other contextual factors which were identified in Chapter 2. This suggests a sub-question about the balance of curatorial and visitor-generated knowledge desired by, and useful to, museum visitors as they construct meanings from artefacts. Another sub-question, prompted by the methodological grounding in activity theory, is the extent to which visitors internalise the trails concept as a form of self-regulation, and conversely externalise it during collaborative trail construction. These two issues are investigated in detail in each of the studies.

This research question has a dual focus: *Can* trails support museum meaning making, and if so, *how* can they do so? One follows *a priori* from the other; therefore the overall fitness for purpose of trails must first be investigated. Thus the first study, detailed in the following chapter, investigates how casual adult visitors approach the activity of trail construction, and it is analysed with regard to meaning making using the TrACE model developed in the previous chapter, with specific analytical tools described below. Successive studies then investigate trails created by primary- and secondary-

level students, in different museum types. Specifically, the first study involves adults on informal visits to art museums; the second takes place in the context of a formal primary school trip to a botanic garden; and the final study involves secondary students in a semi-structured project at a history museum. This sampling strategy is intended provide a broad look at trails' role in meaning making in different types of museums and visitors, and as such it is not aimed at making claims about any one museum type, visitor type, or topic.

Because the nature of trails as defined in this thesis — as a connected sequence of interpretations of individual artefacts or exhibits encountered during navigation of a museum, following Peterson and Levene (2003) — involves the capture of information using a digital 'experience recorder,' the captured data is used as a primary source of data for analysis. Less attention is given to designated 'learning outcomes' except where relevant, than to visitor-constructed products (the trails), and the process of their construction.

As noted previously, this thesis focuses only on in-museum meaning making with regard to trails, not the planning or post-visit editing process, thus no claims are made about long-term learning processes. Therefore, in order to analyse the process of experience recording, direct observation, video recording, and interviews with participants are used. This is supplemented with quantitative data captured by the experience recording technology, but qualitative data from visitors (direct as well as mediated) is given priority. Additional background data are used where available and relevant. All data are analysed using the TrACE model detailed in the previous chapter, initially using tools described below, with the TrACE model adapted iteratively with each study.

Research Question 2: How do portable digital technologies mediate and support trail construction?

Following on from the literature on museum technology and trails, this research question focuses specifically on the 'experience recording' technology itself, and how it mediates, and is used for, trail construction. This question follows from the first question above: If trails as a pedagogic concept can support museum visitors in meaning making, how do portable digital technologies affect trail construction? A crucial sub-question, as discussed in Chapter 2, is how much the technology distracts from museum artefacts, versus how (and how much) it helps in engaging with them.

This question requires focusing on the context of technology use, and the activities in which it is used. If an 'activity system' is the minimum unit of analysis, as in activity theory, the role of technology is necessarily bound up with that of participants, other tools, the environment and the broader culture and history. Therefore, technological mediation must similarly be viewed in a broad perspective — in other words, not focusing on the device itself, as much previous, technology-focused trails research has done.

While the technology itself is capable of collecting contextual data, as discussed in Section 5.1.2, observations and recordings of trail construction activity are important methods for capturing the physical and social conditions in which the activity takes place, as well as its development over time. The TrACE model derived in the previous chapter, and particular tools described below, are used to analyse the effects of technological mediation on trail construction. As Kaptelinin (2008) explains, when studying museum visitors, the essence of what happens during a visit cannot be directly inferred from visitors' external behaviour, which is usually not very complex or varied. Thus, direct and mediated observation are combined with study of visitors' articulated dialogue and the products they produce using the technology. Audio recording is of particular importance in this regard, as a window not only into visitors' interpretations of artefacts but also into their activities and perception of technology, through the 'talk aloud' protocol (Ericsson and Simon, 1993), and through interviews.

Research Question 3: What is an appropriate model for the design and analysis of technology-mediated museum trails?

This question is grounded in the Contextual Model and activity theory, and progresses toward an appropriate model which is specific to technology-mediated trails, as detailed in the previous chapter. As noted in the previous chapter, according to Pierroux, et al (2007), meaning making in museums is under-theorised. Since I focus on the construction of trails using experience recording technologies, this model is focused on the meaning making process within the physical space of the museum, and how technologies can act as a bridge between contexts.

The TrACE model formulated in the previous chapter is developed iteratively with each study. In the manner of design research, as practiced for example by DiSessa and Cobb (2004), the theoretical model is developed in a dialectic process with the practical implementation of the case studies, as the model is put into practice, and findings from practice in turn develop the model. Existing analytical

tools, detailed below, are used initially, and as the TrACE model is developed, it suggests the kind of data to be collected and analysed in each successive case study. Following DiSessa and Cobb, as well as the ethnographic methods of Hammersley and Atkinson (1983), the data then help to drive theoretical development. The specific research plan for investigating these three research questions is detailed next.

5.3 Research plan

This section discusses the details of the research plan used to investigate the research questions using the methods described, including the population and samples of visitor types, settings for investigation, and specific methods used. Based on Crotty's (2003) approach to social research as discussed in the previous chapter, the methodology of activity theory, and the theoretical perspective of the Contextual Model, are intended to uncover meaning making processes, perceptions, interpretations, against the backdrop of constructivist epistemology, as well as constructionist pedagogy.

5.3.1 Population and sampling

Population

As discussed, the main focus of research is to investigate trails as a pedagogical construct applicable across a diverse set of visitor and museum types. Therefore, each study focuses on a different visitor type, which together encompass a very diverse population. In the first study, adult visitors are studied in casual museum visits. The second study involves primary school students, specifically from Key Stage 3, aged 11. Finally, secondary students are studied in an out-of-school, informal museum visit. Together, these groups encompass the three most prominent visitor demographics of museums: adult/family visitors, formal schools visits, and friendship groups. The findings related to each group are not intended to apply to all other visitor types; rather the goal of this sampling strategy, as stated previously, is to investigate trail construction with several visitor types, then to try to draw some common themes.

Different visitor types are known to use museums differently. Casual visitors such as tourists, for example, tend to try and see an entire museum (Czikszentmihalyi and Harmanson, 1999:156), but casual visitors who live locally are more likely to visit particular exhibitions or galleries; both sub-

groups are represented in the first study. Schools tend to target visits at a particular gallery and/or topic. However, teachers' cross-curricular use of museums has been increasing, from four percent of teachers using them in 2003, to 23 percent in 2005 (Hooper-Greenhill, 2006:2). Student use of museums generally has been increasing, with for example two-thirds of London schools having visited at least three museums within the last two years; primary schools tend to visit more than secondary schools (Kofi-Tsekpo and Blay, 2006). The most frequent topic areas in which schools use museums are history, art and design, and science, in that order (GEM, 2006; Hooper-Greenhill et al, 2006; Kofi-Tsekpo and Blay, 2006), and all of these subject areas are represented in the studies. Teachers believe that the use of museum galleries should be structured to some extent (Collins and Lee, 2006:11) and there is evidence that unstructured visits favour emotional and affective gains over cognitive ones (Quistgaard, 2006).

Sampling strategy

The adult visitors in the first study were self-selected from among educated professionals with an interest in, but limited knowledge about, the subject matter of the targeted museum. A small sample of four adults was used, since the study is intended as an initial investigation of how visitors interpret the trails concept at a general level. By contrast, in the second study centres on school visits and collaborative trail construction: four classes of KS3 students participated, each class with approximately 30 students, and the roles of adult teachers, museum staff, helpers and technologists were also studied. Following this broad study, the third study focused more closely on in-group dynamics in trail construction, and therefore involved a single group of four secondary students (aged 16) who worked together on constructing a single trail during a series of informal visits. Together, the three studies therefore encompass a wide range of ages and subject areas, in keeping with the broad study of trails, and inform findings about general perceptions of trails; the personal, social and physical contexts of trail construction activity; mediation by tools and other resources; and narrative and thematic ways of structuring trails.

5.3.2 Research design

Settings

The settings for the studies in this thesis are several London museums, representing a diversity of types and topics. In the first study alone, participants made trails at Tate Modern art museum, the

British Museum, and the Victoria and Albert (V&A) applied art and design museum; these were self-selected by the participants, and encompass topics in history as well as art. The second study took place at Kew Gardens, an outdoor botanic garden, and included the use of its indoor classroom as well as outdoor 'order beds,' on the topic of school science. The final study took place at the Foundling Museum, a small history museum. Thus the subject matter collectively encompasses art and design, science and history. In all cases, the research was conducted around existing museum visits, following the approach suggested by Kondor (2008). According to Hammersley and Atkinson (1983:24) such an approach lessens the danger that the findings can apply only to the research setting, and therefore increases the chances of generalisability.

Data collection methods

The most important data collection method used in all the studies, as suggested by the methodology of activity theory, is the recording of visitor monologues and dialogues, using audio recording technology. As noted, such recordings serve as an externalisation of visitors' meaning making processes. The audio collected includes semi-structured interviews, individual and group 'talk aloud' audio, and the products of trail construction in the form of audio trails. This diversity of recorded data affords a view into trail construction during the construction process, in reflection afterward, and in the final products constructed by the visitors. Looking at these together shows how visitor conceptions about the subject matter, the context(s) and the technology develop during the trail construction process. In terms of the Contextual Model, audio is best suited for capturing aspects of the personal and social contexts of meaning making.

Audio recording is employed in the first study is in the form of visitor-captured monologues and dialogues, using portable digital audio recorders carried and operated by the visitors themselves. The visitors were instructed to construct trails using the audio recorders, specifically: 'make a sequential record of objects or exhibits that interested you.' The ways that they interpreted this task are analysed using the audio they recorded, using the analytical tools described in the following sections. In the second study, audio is one of three modes captured by the technology used by the visitors — mobile phones with bespoke software. Visitors were instructed to capture audio as evidence to support their scientific hypotheses, in the form of a trail; specifically in the form of descriptions, explanations, and interviews with fellow visitors. As in the first study, the audio is analysed as a product of visitor trail construction, in this study using a further developed TrACE conceptual model. In the second study, audio is also captured by me in the form of recordings of visitors' and other participants' activity

during trail construction. These comprise informal interviews that I conducted during the activity, and 'ambient' audio of participants dialogues during the activity. Formal interviews were also conducted by me and another researcher after the study; these are included in the analysis by the TrACE model, and are discussed in further detail in Chapter 7. In the final study, most of the data comprises audio — as a product of trail construction, through ambient audio recorded by the participants during the activity, and in formal interviews conducted by me both before and after the activity. In this study visitors were instructed to construct an audio trail, and to record their own discussions during the activity; specifically they were to use the devices given them to record interpretations, rehearsals, their discussions, and the final trail. As before, all the audio is included in the analysis using the TrACE model.

Video recording and still images are also used in the second study, primarily to capture visitors' activity and aspects of the museum context, including physical settings, social dynamics and interactions. Video and image data also captures visitors' use of portable digital technologies as they collaborate to accomplish goals, and negotiate interface features. Such mediation is analysed using the TrACE model developed in the preceding study. The visitors were informed about, and consented to, the video recording. For both audio and video data, all the visitors were told that their data would be used for research and for dissemination of the research, and that no images of the participants would be disseminated without their consent.

Also included in the data collection are other materials utilised by visitors, including paper-based material used and filled in, interpretive tools in the museum including labels and guidebooks, and other resources such as curriculum guidelines, worksheets and instructions. These data supplement the primary data (visitor products and recorded activity and dialogue), and help to provide a broader picture of the entire activity system and context(s) in which trail construction takes place.

In all of the studies, participating visitors and educators were asked to consent to their voices, still and video images (in the second study), and the materials they used and constructed to be used for this research. Video presents particular issues when used with children, in that under commonly practised ethical guidelines, as for example codified by the Institute of Education, images of identifiable children cannot be published without informed consent. When children are in control of recording devices, they may for example record other visitors who have not consented to participate in the study. In the second study, some students took still pictures of other students in their class, but not of other visitors; any images determined by me to be unrelated to the task at hand were identified as

such and not used. In the third study, the visitors asked not to be recorded on video and I complied with this.

Table 5.1 summarises the three studies; then the initial data analysis tools are detailed in the next section.

Study 1: Trail construction by adult visitors in art museums		
Participants	*Activities*	*Tasks*
2 single visitors; 1 pair	Trail construction art museum of visitor's choice using portable digital audio recorder	Trail construction as interpreted freely by each visitor, focusing on how visitors interpret trail construction, and on audio as mode/mediator
Study 2: Trail construction by primary students at a botanic garden		
Participants	*Activities*	*Tasks*
4 classes (Year 5 / KS3 / age 11), each approx. 30 students each, divided into groups of approx. 5; plus teachers, museum educators, technologists, researchers and other adult facilitators	Trail construction at botanic garden using mobile phones (1 per group) with bespoke software enabling audio, image, text capture	Trail construction on the topic of food plants, 1 plant family assigned to each group; focusing on collaborative trail construction, comparison of capture modes, interpretation of a topic-centred trail
Study 3: Trail construction by secondary students in a history museum		
Participants	*Activities*	*Tasks*
3 students, all aged 16, plus museum educators	Audio trail construction at history museum using portable digital audio recorders	Visitor-defined/negotiated trail and topic, focusing on structure of trail construction, use of the trail, and multiple mediators

Table 5.1. Summary of the three studies.

5.3.3 Assessment Tool for analysis of museum contexts

The Contextual Model of learning, consisting of personal, social and physical contexts, as described in detail in the previous chapter, provides a theoretical perspective for analysing trail-based meaning

making in museums, given its role as a prominent contemporary museum learning theory, and its focus on the museum context.

The authors admit that it is not a model in a true sense, intended to predict what visitors will learn; they view it rather as a way of conceptualising visitors' meaning making as a continuous dialogue with their physical and social contexts; hence its use as a grounding theoretical perspective in this thesis. The model has not been used previously for research of the type undertaken in this thesis. However, Falk and Dierking (2003) developed a 'Family Learning Assessment Tool' based on the Contextual Model. This was designed for use by museum educators to evaluate exhibit 'clusters' or groups of proximally-located exhibits on the same topic, with regard to meaning making by visiting family groups. The tool consists of indicator questions supported by checklists of specific characteristics, relating to the personal, physical and sociocultural spheres of the Contextual Model. The personal and physical contexts are evaluated by comparing the exhibits under study to the indicators in the Tool; the sociocultural context is further supported by direct observation of visitor interactions. The original Assessment Tool is included in Appendix 1, and an excerpt appears in Figure 5.1.

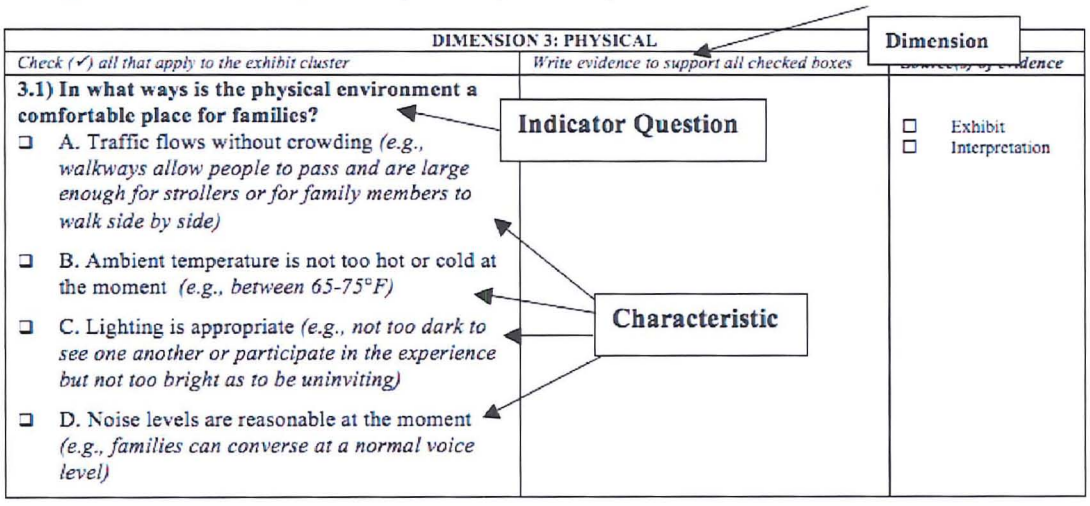


Figure 5.1 Excerpt from the original (unmodified) Family Learning Assessment Tool of Falk and Dierking (2003)

As an initial deployment of the Contextual Model as a theory, and as a means of informing the development of the TrACE model, I adapted the Assessment Tool for use in analysing data in the first study, in the following ways.

Adapting the Assessment Tool for analysing technology-supported activities such as trails requires shifting focus on several levels. First, the main object of analysis must shift from in-gallery exhibits and interpretive materials to the personal technology carried by the visitors themselves. At the same time, such technology must be studied with regard to the extent to which it mediates visitors' encounters with the artefacts and interpretation. Thus, for example, instead of evaluating elements of the physical context in terms of their support for visitors' meaning making, a trail must be studied with regard to the extent to which it supports physical context variables. Trail-related technologies, as described in Chapter 3, are oriented to collecting visitor-generated data, not to delivering exhibition information. Thus the sources of evidence for perceived 'learning indicators' in the original Assessment Tool were changed to *referents* in the modified Assessment Tool; in other words, the modified Assessment Tool is intended to identify visitors' references to the personal, physical and sociocultural contexts, not to look for evidence to support these contexts in the exhibits.

I added the following sections to the Assessment Tool, because they are present in the Contextual Model, but were not represented in the Tool:

- Section 2.7: Choice and control over the visit (Personal and cultural context);
- Section 3.3C: Sharing experiences — other locations (Physical context);
- Section 3.4 Navigation and orientation (Physical context); and
- Section 3.5 Design of exhibitions, programmes, technology (Physical context).

As with the rest of the Assessment Tool, these sections are intended to identify references by participants to the given topic. For example, 'choice and control' was deemed an important part of visitors' personal context, as described in the previous chapter, with particular relevance to visitor-constructed trails. Section 3.3 of the original Assessment Tool includes as places for sharing experience only in seating areas; thus I added an 'other' category. Navigation and orientation are central to trail construction, as discussed in Chapter 3, and so were added as a category. Finally, the design of exhibitions and other aspects of the physical context were shown in Chapter 2 to affect visitor meaning making, and thus were also added.

The modified Assessment Tool informs the TrACE model as shown in Figure 5.2: specifically, it illuminates visitors' personal, social and physical contexts as they encounter individual artefacts.

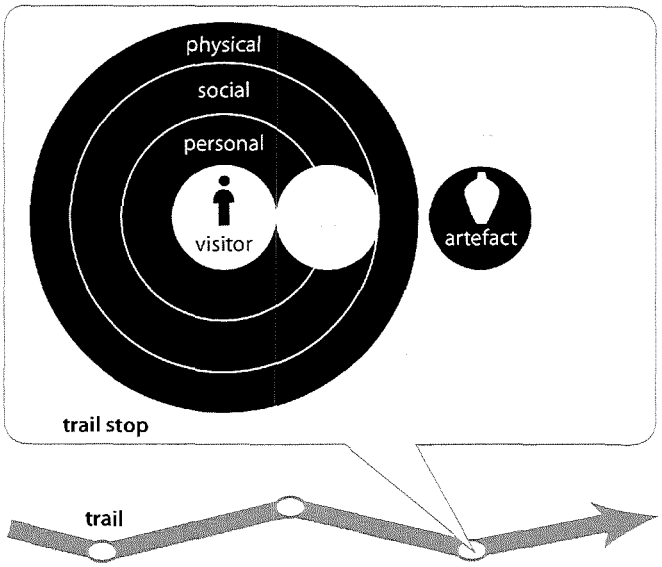


Figure 5.2 TrACE conceptual model with areas covered by the modified Assessment Tool highlighted in black.

The Assessment Tool could be used in its original form to assess 'exhibit clusters,' and augmented with a separate evaluation of the portable digital technology. But in the case of trail construction, the technology is intended to be used *across* different exhibits, exhibit clusters, and galleries, with the goal to support an entire museum visit; a trail facilitates links *between* exhibits and with visitors' personal and social contexts. Thus, evaluation of individual exhibits or exhibit clusters is less relevant than a higher-level analysis of the trail of the complete visit. In other words, meaning-making must be analysed at the level of the visitors, not the exhibits. The original Assessment Tool accommodates observations of multiple visitor groups around a single exhibit cluster; the adapted Assessment Tool must target a single visitor or visitor group across multiple clusters.

The original Assessment Tool is clearly oriented to science museums, as reflected in its focus on family groups, and with references to interactive exhibits. By adapting it, I intended to apply it more broadly to any visitor segment and any type of museum (adhering to my definition of museums described at the start of Chapter 2). Therefore, instead of exhibits or exhibit clusters, my adapted

Assessment Tool focuses on artefacts. The original Tool's definition of 'exhibit clusters' assumes physical proximity; trails make conceptual or thematic links between exhibits which may or may not be in close proximity.

The original Assessment Tool is specifically aimed at improving exhibits, and thus refers to 'ideal' conditions such as low noise levels. It stipulates for example, 'The data collector should check all of the characteristics that apply to an exhibit cluster.' In contrast, trail analysis is not aimed at improving a museum's offering but at analysing visitor meaning making, and thus while it may refer to some of the same factors, it should list negative aspects as well as positive. The complete adapted Assessment Tool is in Appendix 2.

5.3.4 Activity Checklist for analysis of tool mediation and activity

As an initial methodological deployment of activity theory (AT) I use the 'Activity Checklist' (Kapteinin and Nardi, 2006; Kaptelinin et al, 1999). It reflects the five basic principles of AT described in the previous chapter, and acts 'as a guide to the specific areas that a researcher or practitioner should be paying attention to when trying to understand the context in which a tool will be or is being used' (Kaptelinin and Nardi, 2006:269). It was developed to introduce AT to the field of interaction design. Macaulay (in Kaptelinin et al, 1999), for example, found it useful to guide interviews in fieldwork.

With its focus on technological mediation, it is used in this thesis to complement use of the Assessment Tool described in the previous section; as discussed in the previous chapter, AT can complement the Contextual Model. The Activity Checklist supports this not only by focusing on physical, social and personal aspects of activity, but also by extending the scope to include goals, tool mediation, and the development of activity. The Activity Checklist is intended to act as a 'contextual design space' for identifying areas of particular focus for informing research questions (Kaptelinin and Nardi, 2006). Relevant topics can then be elaborated by moving up or down the hierarchy of activity, actions and operations. The authors provide two versions — one for evaluation and one for the design of technologies. I use the 'evaluation' version, which is described next, since it is used to evaluate technology use in the first study, not to inform the design of a particular technology. The complete Activity Checklist appears in Appendix 3. The sections of the Checklist are as follows:

Means and ends

This section of the Checklist evaluates the extent to which technology facilitates or constrains users' goals. It focuses on the hierarchical structure of activity specified in AT, first identifying people, goals (decomposed into subgoals), criteria for success, conflicts and their resolution. The scope is then extended up to include users' motives, and down to include particular actions and operations.

Environment

This section focuses on both the social and physical contexts of technology use, focusing for example on how the technology integrates with other tools and resources, and how an activity is divided among participants to accomplish goals. Regarding the social context, it also calls attention to any rules, norms or procedures operating in an environment.

Learning/cognition/articulation

In the context of a meaning making activity such as visitor-constructed museum trails, this is perhaps the area of the Checklist which will require further the most attention, since it seems to separate out learning, cognition and articulation as separate factors in what it regards as the broader activity of technology use. Within this area, it draws attention to internal (cognitive) and external (social) components of activity, aiming to identify technological support for their mutual regulation, on the assumption that technology should support both internalisation and externalisation of concepts during meaning making. This includes concepts related to the technology itself, and any effort needed to learn to use it. 'Breakdowns' in users' understanding of the technology are identified, as well as any help in resolving them. The tool does not however seek to identify 'breakthroughs' — what in constructionism are features of technological tools which make possible ways of doing and thinking not possible without the tools.

This part of the Checklist does, however, look at how the technology facilitates the coordination of group activities, and at shared representations of collective knowledge. These are also key aspects of collaborative learning (e.g., Järvelä and Häkkinen, 2005; Crowley and Callanan, 1998), and can thus help identify whether visitors are integrating knowledge; these are further explored in the next section of the Checklist.

Development

The final section of the Checklist looks at how the activity develops over time; specifically at the transformation of concepts, goals, attitudes, activities, and the environment. It looks for these in overlaps between internal and external representations of ideas, and individual versus collective knowledge building.

In summary, the Activity Checklist aims to identify particular areas of possible conflict — between visitors' conscious goals and the object of activity for example, or between individual and collective goals. I specifically use this Checklist in the first study, and thereafter aim to reconcile AT with the Contextual Model in my own TrACE model. The relationship of the Activity Checklist to the TrACE model is shown in Figure 5.3. Specifically, the Checklist focuses on tool-mediated encounters with the activity contexts of artefacts. While this covers visitor meaning making as well as the social and physical contexts, it is in relation to the goal-oriented activity, specifically the mediated capture of data and interpretations related to artefacts for the purpose of trail construction; visitor contexts are covered by the modified Assessment Tool discussed in the previous section. Thus, the two analytical tools together inform the development of the TrACE model.

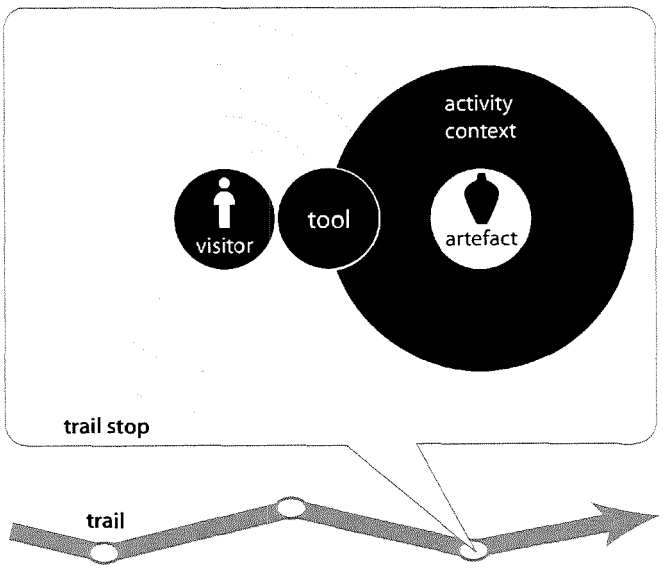


Figure 5.3. TrACE model with areas covered by the Activity Checklist highlighted in black.

5.4 Conclusion

This chapter discussed methodological issues related to museums, portable digital technologies, activity theory and trails. Based on the literature review and theoretical framework developed in the preceding chapters, I have formulated the following research questions:

1. (How) can visitor-constructed trails support meaning making in museums?
2. How do portable digital technologies mediate and support trail construction?
3. What is an appropriate model for the design and analysis of technology-mediated museum trails?

Together these are aimed at investigating trails as a pedagogical concept and an activity for structuring museum visits. Additionally I look at the technological mediation of trail construction, and at validating and developing the TrACE model for analysing the activity and contexts within which trails take place. The specific methods selected for investigating each question were detailed, and the informants and setting of the investigation described. Two existing analytical tools, based on the Contextual Model and activity theory, as used in this thesis, were then described, and in the former case, adapted. These are used for data analysis in the following chapter, which describes the first study, in which adult casual visitors use audio recording technology to construct trails in museums. The data generated from all of the studies in this thesis are intended, collectively, to investigate the value of technology-mediated, visitor-constructed trails for meaning making in museums, and to iteratively develop the conceptual model for their design and analysis.

Chapter 6
Study of trail construction by adult visitors to art museums

In the previous chapter, the following research questions were formulated:

1. (How) can visitor-constructed trails support meaning making in museums?
2. How do portable digital technologies mediate and support trail construction?
3. What is an appropriate model for the design and analysis of technology-mediated museum trails?

Following from these, and the methodology described in the previous chapter for investigating them, the aim of the study described in this chapter was to obtain an initial understanding of how visitors interpreted the term 'trail' (Question 1); to investigate audio as a method of data collection as well as 'experience recording,' to use Peterson and Levene's (2003) term (Question 2); and as an evaluation of two existing analytical tools for the purpose of developing the TrACE model formulated in Chapter 4 (Question 3). More broadly, this study was intended to illuminate key themes requiring further investigation.

The setting and sample are first described, the collected data is then described, and is then analysed using the modified Assessment Tool and Activity Checklist described in the previous chapter. A discussion then follows about how this study informs the research questions and TrACE model, based on the analysis, thus informing the next study.

6.1 Research design

6.1.1 Setting

This study was conducted between January and May of 2006, and involved three different museums: Tate Modern, the British Museum, and the Victoria and Albert Museum (V&A). All three museums fit the definition of museums formulated in Chapter 2, put simply, as collections- and education-focused. Tate Modern is distinct in that it is considered purely an art museum, while the other two generally use their collections to exemplify particular cultures and/or historical eras. With its collection of modern-era as well as contemporary art, Tate Modern, like other art museums, was closer to 'classical' museums such as the V&A and British Museum, in that it displayed its collection roughly in chronological order, thereby similarly using the artworks to represent particular historical periods or schools of art. However, after several years, Tate Modern, along with other museums such as the Museum of Modern Art (MoMA) in New York, began experimenting with alternative, thematic displays, sometimes grouping artworks from disparate geographical locations or time periods, influenced by postmodernism and critical theory. Since then however, both Tate Modern and MoMA have returned to more traditional, chronological displays for the most part, due in large part to criticism from visitors. This point is raised in the trail constructed at Tate Modern in this study. Generally, all three of the trails in this study focus on artworks and the aesthetic qualities of artefacts visited; historical periods and/or cultural issues associated with particular artefacts are discussed to varying degrees.

None of the museums was approached to formally participate in this study, the intention being to replicate a 'natural' visit as much as possible; if any of the participants had been stopped by museum personnel from using recording tools in the galleries, this would have been treated as data. In the event, they were not.

6.1.2 Sample

The sample for this study included two adult individuals and one pair, each of whom constructed trails using portable audio recorders. Informal adult visits were targeted because family and school trails already exist in museums, mostly in paper-based forms, and thus have existing preconceptions associated with them. Trails as described in Chapter 3, however, are an emergent, visitor-constructed

phenomenon, and this study thus targeted average casual museum visits. The sample was self-selected, being respondents to a call issued by me, via email, for participants. This call was issued to fellow researchers in social science and computer science; as academics working in the Higher Education sector, these individuals tend to conform to the average profile of adult casual museum visitors, who, as described in Chapter 2, tend to have higher levels of education than the general population, and regularly attend cultural events and venues, though they may have little or no prior knowledge about a particular artist or exhibition. Respondents in this study had no prior knowledge about museum meaning making research generally, nor about trails specifically.

6.1.3 Data collection and analysis methods

I aimed to collect data for this study by means of 'experience recording' as described by Peterson and Levene (2003) in their definition of trails, but using readily available existing technology, given the aim to investigate familiar technologies already being carried by museum visitors; and given the technical issues with automatic trail recording systems reported in Chapter 3. A simple and seemingly effective solution was to record visitors' narration, or dialogue, as they navigated through a museum. I offered the option of using the participants' own recording device, or an iPod recorder provided by me. As described in Chapter 2, audio recordings of visitors can yield a rich source of qualitative data, since a recording device prompts visitors to externalise their thinking, thereby promoting group and self reflection (Allen, 2002).

Peterson and Levene (2003) envision an experience recorder as automatically tracking a visitor's location in the museum. However, I hypothesised that simple audio recording could eliminate the need for location tracking technology if the visitor could simply speak the chosen location into the audio recording device. A precise location could be most easily pinpointed by reading an artefact label, or by otherwise identifying an artefact of interest; secondarily, location could be determined by describing one's position in a particular museum gallery. If locations could be determined from one or both of these methods, a trail of physical locations could then be constructed which would be as accurate as a trail created automatically; indeed it could be more accurate since, being user-selected, it would be free of the spurious data points generated by the automatic tracking system described by Papadogkonas, et al (2008). Additionally, it could yield a valuable source of qualitative data, specifically visitors' own interpretations of artefacts and locations; such qualitative location data could thus inform navigation and orientation from the visitors' perspective.

The trails constructed in this study therefore serve as concrete products of visitor activity, as well as self-reported ethnographic accounts about museum visiting. According to Hammersley and Atkinson (1983:107), such accounts are not simply representations of the world but part of the world they describe and are thus shaped by the contexts in which they occur. Therefore the authors suggest treating such accounts as both resource and topic.

Three people responded to my call for participants. I specified that trails should be restricted to between five and nine stops or artefacts, following Miller's (1956) finding about the limitations of short-term memory as discussed in Chapter 3, on the assumption that if all the individual artefacts or exhibits in the trail could be held in working memory, this might better facilitate making links between them. I also specified that the name of the museum and the date should be provided as an identifier for the trail. Though any museum was acceptable, large, diverse museums such as the British Museum and Tate were suggested, in keeping with Peterson and Levene's (2003) focus on unstructured or semi-structured information spaces in which visitors would be more likely to create their own thematic links, and Falk and Dierking's assertion that non-linear museums or exhibitions are more suited to 'personalised' meaning making, because they offer more visitor choice and control (Falk and Dierking, 2000:182), discussed in Chapter 4.

To facilitate analysis, the audio data from each trail were first transcribed by me. The data were then analysed using the two tools described in the previous chapter: the modified Assessment Tool of Falk and Dierking (2003), and the Activity Checklist of Kaptelinin and Nardi (2006). The modified Assessment Tool was used to categorise segments of audio trail data in relation to the sociocultural, personal and physical contexts of the visitors, using indicator questions in each category; the original and modified versions of the Assessment Tool appear in Appendices 1 and 2. The Activity Checklist was used to identify relevant aspects of tool use and mediation, using the four categories of means and ends, environment, learning/cognition/articulation, and development. The complete Activity Checklist appears in Appendix 3. The findings from the analysis inform the development of the research questions and conceptual model in Section 6.6.

6.3 Description of the data collected

In this section, each of the constructed trails is described; the trails are then analysed in the following section. Though the visitors were all adult academics, the trails constructed by them are all very

different in form and content, and raise different but interrelated issues, as each of the visitors interpreted the task and the trails concept slightly differently.

One adult male created a trail using an iPod at the V&A with five recordings, each less than one minute, and each corresponding to a particular artefact in the museum. A second adult male made a trail using an iPod at the British Museum, with six recordings of approximately 30 seconds each, again relating to one artefact each. Finally, a male-female pair made a trail at Tate Modern using their own digital recorder, with two long recordings and one brief one, together adding up to nearly an hour of continuous narration, as the pair navigates through a large portion of the museum.

Each of the trails described below is treated as a mini-case study. Since the first two trails are brief, they are transcribed in their entirety; the longer trail is excerpted, with the complete transcript in Appendix 4. In each case I have reconstructed the trail locations, based on descriptions of artefacts and galleries given in the audio, and these are shown in figures in the text. Names have been changed to protect anonymity.

6.3.1 Keith at the V&A

This trail was recorded on 15 February 2006 in the afternoon. Keith is an education researcher living in London. Transcripts of the recordings follow. Note that the first few seconds of each recording are cut off, due to a technical fault in the iPod.

Recording 1

Time: 13:14:51
Duration: 32 sec.
'... stop in the trail in the China gallery. This is a thing you simply can't miss. It's an Imperial throne that's red, carved lacquer on wood, 1775-1780, the Qing dynasty. It's right in the middle of the gallery really, uh, near the front. It's a big, uh, about 3 foot wide, quite ornately carved. Uh, very red, with black and gold designs. Really striking.'

Recording 2

Time: 13:16:56
Duration: 29 sec.

'... contemporary piece, uh, from 1990, Taiwan, that's a natural sculpture. Uh, it's called Sublimation. And the artist is Tsang-i Bair [name was spelled out in the recording]. Uh, it's in the middle of the gallery, in a big case sort of right in the centre of the gallery, uh, in a case with three pieces. It's a big centre piece, sort of a wispy driftwood uh, sculpture.'

Recording 3

Time: 13:20:00
Duration: 34 sec.
'...on the right side of the gallery, something quite unusual - a carved Chinese cabbage, with a grasshopper on top. Uh, the entire thing carved out of ivory and stained sort of yellow brownish, um, some blue tones. Uh it's from 1950 to 1970. Un, sort of jumps out of the case as something quite unusual in relation to everything else - sort of pots and stoneware plates and things like that.

Recording 4

Time: 13:21:43
Duration: 1:02
'... abstract painting. Sorry you can hear the rustling of my bag, I've just come from the shop. A big abstract painting, directly, or sort of right in the centre of the gallery, across from the, that sculpture. It's quite interesting. I'm not sure the name, hold on.' [break] '...Dreaming. Uh, it's watercolour and ink on paper, and it's by Chan Ky-yut [name spelled out]. It's from 2001, Canada. Um, it's big, it's about 12, 14 feet wide by, maybe 6 feet high. Uh, lots of different colours, uh looks quite contemporary. Um, very minimal and quite abstract. And it has a, is watercolour, kind of wispy and faded a bit.'

Recording 5

Time: 13:24:30
Duration: 40 sec.
'Um, I'm on the far wall of the gallery. Burial object, quite old. It's a horse; there are several horses, this one kind of on the left side, uh, in a case with a lot of other animals and objects. Um, this one is called Standing Horse. It's earthenware, with amber-lead glaze, from the 1st or 2nd century, Eastern Han dynasty. Uh, it's just a beautiful, beautifully formed, uh, horse really. Uh, about 3 feet high, 3 to 4 feet high actually. Just a really pleasing sort of shape.'

The transcript shows a problem with the technology, specifically that the iPod does not begin recording until about 3 seconds after the user pushes the Record button, resulting in some lost data. This is particularly problematic in the break in the middle of Recording 4, after which the artefact is identified, making it more difficult to reconstruct the trail. Besides this, it was a minor technical issue.

It is clear from the first recording that this trail took place in the China gallery of the V&A, which contains a mix of pre-historic, historical and contemporary artefacts, some of historical or cultural significance, others as representative artworks from different eras. The gallery is divided into several themes, including 'Living,' 'Ruling,' 'Collecting,' 'Temple and worship,' and 'Burial.' From the transcript, Keith appeared not to have taken these into account, but instead selected individual artefacts regardless of theme, constructing a trail based solely on aesthetic preferences. He devoted most of the recordings to descriptions of the artefacts, their location in the gallery, and text label information, even spelling out names. From his descriptions, and from my own subsequent visit to the gallery to locate the artefacts, I have reconstructed his trail in Figure 6.1.

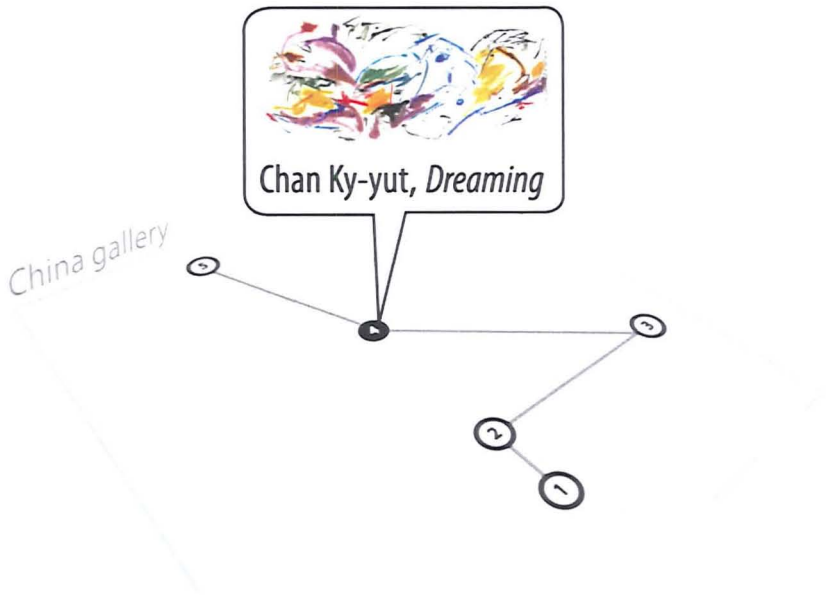


Figure 6.1 Representation of Keith's trail in the V&A's China gallery, with sections of the gallery labeled, and numbers circled in black representing each trail stop; one stop is highlighted with an image from the artist's Web site.

The trail representation in Figure 6.1 shows that Keith visited a large portion of the gallery. It does not attempt to show the actual path he travelled from one artefact to the next; he may have wandered in a much less direct route between the artefacts than is depicted, and other artefacts encountered may have influenced his choice of selections to include in the trail. However, the fact that each recording takes place about two minutes apart indicates that he probably took a fairly direct route, and this time frame conforms with the average time visitors encounter artefacts, as described in Chapter 2. There is little indication whether any other artefacts influenced his choices, except for his repeated choice of artefacts which appear striking or unusual to him, and which therefore stand out from other artefacts in the gallery. As stated by Falk and Dierking (2000) as well as Czikszentmihalyi and Harmanson (1999), museum visitors seek a mix of novelty and predictability.

Keith made little attempt to tie the artefacts together in the trail; in Recording 4, he referred to the artefact from the previous recording only as a means of describing his location. The fact that his trail happened to move from the 'Ruling' and 'Living' sections through to 'Collecting,' then 'Burial' is probably more a factor of the design of the gallery (the physical context) than Keith's choices, since the entrance to the gallery from the museum's main entrance is located at the bottom of the map in Figure 6.1. Keith also indicated in Recording 4 that he had just come from the shop, which is directly adjacent to the gallery. It is notable, however, that he restricted his trail to a single gallery, in contrast to the other trails collected in this study. The other two trails are described next, before all the trails are analysed in Section 6.4.

6.3.2 Tim at the British Museum

This trail was recorded on 14 March 2006 in the afternoon. Tim is a computing lecturer living in New York City, and this trail was constructed during a visit to London to attend an academic conference. As in the previous trail, the following transcripts encompass the entire trail.

Recording 1

Time: 14:20:53
Duration: 26 sec.
'...Chinese section looking at, a bunch of schoolgirls. Uh, and the bronze temple bells from the Qing dynasty, 1644 to 1911. Nice bells.'

Recording 2

Time: 14:22:15

Duration: 2.08

'... the script on them, in brass, and given the date, you know, we're looking at this bronze bell is, like 1411 or so. You know, to be able to pull off that kind of detail is amazing to me.

[break]

'"...underscores how people everywhere deal with the tough realities of life, the challenges we all share with their many different responses." Um, I kinda wanna go and see the Easter Island figure because after reading *Collapse*, I got really interested in Easter Island and how the um, they basically chopped down all the trees, and how that had everything to do with why the society died. And you know, he mentions in the book that you really just kinda wonder, What would make you chop down the last tree?'

[break]

'"Hakananai'a - probably stolen or hidden friend." Um, was donated to the museum by Queen Victoria, interestingly enough. Um, it's kinda short. I mean you always think of the Easter Island statues and you think they're gonna be a lot taller, but this one's pretty short.'

[break]

'...sickness and dying. Just layers and layers and layers of pills. And, photos around the edge, of people from, you know various either illnesses, some x-rays, so-and-so taking his pills. I mean, the thing that strikes me about is, this really doesn't tell me anything about this whole line of pills in front of me. It just uses them as sort of, wallpaper.'

[break]

'"...one man and one woman's life, and the various drugs they've taken over the course of a lifetime." And um, that's a lot of drugs. It's actually pretty cool when you look at it that way.'

Two things were immediately clear about the recording of this trail. First, the same problem with the iPod resulted in the first few seconds of each recording, and after the pauses within the recordings,

being cut off. Second, in the second recording Tim used the Pause button between recordings, instead of the Stop button which would have resulted in individual tracks. Thus the second recording could be considered as five discrete trail stops, though there are clear links between the recordings as well.

From Tim's descriptions and my own knowledge of the museum, I reconstructed his trail, as shown in Figure 6.2.

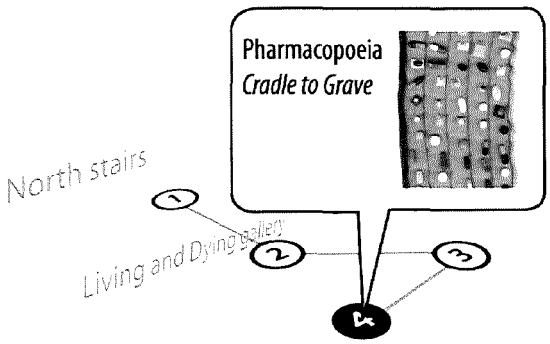


Figure 6.2 Representation of Tim's trail in the British Museum, with galleries labeled, and numbers circled in black representing each trail stop; one stop is highlighted using an image from the museum's Web site.

In contrast to Keith, Tim did not restricted his trail to a single gallery. His trail began in the stairs near the rear entrance to the museum, where it can be reasonably assumed he entered. In the first stop he mentioned a group of schoolgirls which seemed to affect his navigation. Like Keith (and most casual adult visitors, as discussed in Chapter 2), Tim did not have a particular theme or goal in mind in navigating the museum. The Chinese temple bells in the stairway attracted his attention. Tim identified these from their text label, which was useful for me in reconstructing the trail (since these bells do not appear in the museum's online catalogue and might be confused with Japanese temple bells which do). Like Keith, Tim ended the first recording with his direct reaction — 'Nice bells.'

In contrast to Keith however, Tim's second recording, begun approximately one minute after the first one ended, indicated that he had been studying the bells more closely. As discussed in Chapter 2, visitors seldom spend more than 30 seconds in front of any particular artefact, thus a full minute may indicate particular engagement or interest. This is supported by Tim's comments beginning Recording 2, expressing surprise that such intricate carvings in brass could have been executed so long ago. This

could be considered a slightly deeper layer of interpretation than Keith's comparatively superficial reactions.

The next recording was made by Tim at the entrance to the 'Living and Dying' gallery, where he read from a wall text introducing the gallery. He was then attracted by a large figure at the other end of the gallery, which related to a book he read. Once at the artefact of interest, he read the text label into the recorder, and again recorded a personal interpretation in the form of surprise, in this case that the Easter Island figure was not as tall as he expected it to be.

Tim's final stop was a display of pills in the centre of the gallery, an art installation called *Cradle to Grave*. He again expressed surprise, this time at the lack of interpretation provided by the museum. In the final recording however, he had subsequently found the descriptive label, and this changed his view of the installation: 'It's actually pretty cool when you look at it that way.' This is a clear example of the museum interpretation having transformed Tim's thinking about the installation; he was impressed by the amount of medicine one couple consumes in a lifetime — indeed a common reaction among visitors, judging from my own informal observations, and presumably one of the intended purposes of the installation.

6.3.3 Rachel and Adam at Tate Modern

Rachel is a London-based education researcher and former teacher. She chose to create an audio trail with her partner, Adam, who is a musician, at Tate Modern on 14 May 2006, using her own portable digital audio recorder. The result was three digital files, with duration of 26:51, 21:27, and 2:27 respectively. The trail was recorded as a nearly continuous narration of the visit, though the two longer files contain pauses which are difficult to discern without explicit identification from the narrator. Rachel carried the recording device throughout the entire trail, and the recording included her speaking aloud as well as conversations between the pair. As a continuous narration, this trail was a rich source of data. Due to the length, instead of providing a complete transcript, here I give a roughly narrative description, with excerpts; a portion of the trail is plotted in Figure 6.3.

The visit began in the museum's Turbine Hall where the couple hoped to see an installation, but it had already closed. They discussed what to see next, with Rachel suggesting, 'We could go see the Monet, 'cause, well, we have to make sure to watch the Monet programme tonight. It's been really advertised

heavily on the radio...' (Recording 1, 1:53) After spending a few minutes simply watching people in the Hall ('It is kind of interesting watching people interacting in a blank space' (Recording 1, 2:50), they decided to wander through the galleries, and after a break in the café, visited a special exhibition, *Bauhaus to the New World.*

Generally, the pair's references to particular artefacts were descriptive (e.g., 'Oh, that's a famous one,' Recording 1, 7:54). However, Rachel also identified them by name in many cases, prompted by my instruction to read out artefact labels. Most often these come with either a cursory reaction ('It's a nice painting of the sea though,' Recording 1, 7:17) or somewhat deeper interpretation ('He looks a bit worried, he has a furrowed brow,' Recording 1, 6:57). From their descriptions, I reconstructed their trail, a portion of which is shown in Figure 6.3.

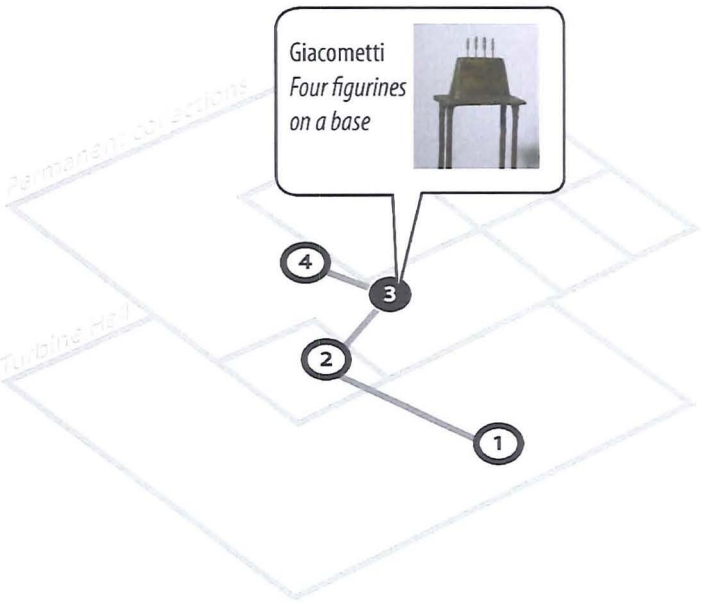


Figure 6.3 Portion of Rachel and Adam's reconstructed trail, shown stretching across two floors of Tate Modern, with one trail stop highlighted, using an image from the museum's Web site.

There were several personal references in the trail. For example:

> 'When I was at university I had a poster of a Giacometti on the wall.' (Recording 1, 4:34)
>
> 'Oh a whole Rothko room, cool. He was in the movie last night, in the chick flick that Jo and I saw.' (Recording 1, 13:34)

'Looks like the balconies at your flats.' (Recording 2, 8:28)

'I could see some of those things in the flat.' (Recording 2, 12:03)

Adam had an interest in Frank Lloyd Wright, and spent the start and end of the visit looking in the shop looking for a relevant book. They did eventually come across one of Monet's water lily paintings, which the museum had placed next to a Rothko painting. Rachel followed the suggestion of the interpretive text and compared them: 'I like how they, how the colours in the Rothko are the same as the colours in the water lillies' (Recording 1, 11:59). Rachel also attended to other interpretive materials: 'I'm gonna read the thing on the wall. 'Cause that always helps me' (Recording 1, 4:50). They also helped each other: 'Schwarz - that means black,' Rachel explained to Adam, referring to a film caption (Recording 2, 13:02).

Their visit extended beyond looking at artworks; windows and balconies overlooking London prompted conversations about landmarks they saw, and the weather. They commented on Tate Modern's architecture: 'I love these floors. The wood is just fantastically kind of rustic' (Recording 2, 2:49), and about the way the artwork was arranged across the museum: 'Oh, I like the way it was before. I thought it was really inventive. They had themes, instead of going chronologically, which is kind of the standard museum thing' (Recording 2, 3:12).

There were references to other visitors, mostly as environmental features ('Alright, the queue's too long so we're changing our minds,' Recording 1, 18:35), but also in relation to artefacts: 'these other women were laughing at it, so I was kinda curious' (Recording 1, 5:53). They referred to their own belongings ('D'you want me to carry the bag?' Recording 2, 5:17), and Rachel's membership card, which got them into the members' lounge and the special exhibition for free.

One of the most interesting conversations was triggered by a moving sculpture by 20th century modernist Lazlo Moholy-Nagy. The conversation could be easily have been heard in a science museum; it contained open- and closed-ended questions, explanations negotiated in dialogue, and references to other experiences; and it showed their inter-relation within a conversation:

R: What made that ball move? Did you see the ball move?

A: No

R: [gasp]

A: Did it go up and down?

R: Yeah it rolls, along the track. OK, it's coming around. D'you see the ball? It rolled along that track.

A: OK.

R: Wup, wup, is the track going up?

A: It's tilting down. Yeah, that thing has moved up.

R: Whoa. Ok so what's making the big round move up?

A: Well it's a motor.

R: Really?

A: Could use a cheese grater there. That's really nice isn't it?... Looks like something from a *Doctor Who* set.

R: [laughs]

A: ... cybermen

R: Yeah. That's what happened when the tardis crashed.

A: It's giving me a headache.

R: Look at the shadow on the wall. That's pretty cool...

[...]

A: Want to see the ball move

R: There it goes there it goes there it goes

[click]

R: Mm, OK.

A: OK.

(Recording 2, 13:49 - 15:59)

They made a few references to the recording device:

'I paused the recorder' (Recording 1, 21:04)

'Track 2' (Recording 2, 0.00)

'I forgot it's being recorded' (Recording 1, 20:49)

At the end, Rachel concluded with, 'That was our Sunday navigation of Tate Modern' (Recording 3, 2:07)

In summary, two brief trails and one longer trail provided different interpretations of the trails concept, a variety of references to personal, social and physical contexts, and different uses of the technology. The trails are analysed together in the next section.

6.4 Analysis of the trail data

The trails constructed in this study were intended to inform all three research questions: to provide a baseline understanding of how adult visitors interpreted the trails concept (Question 1); to investigate audio recording, as both a method of trail construction and a means of data collection (Question 2); and to inform the development of the TrACE model (Question 3). In this section, the data analysis is divided into two parts. First, the trail data is analysed using the modified Assessment Tool, then using the Activity Checklist, both of which were described in the previous chapter. The relation of each tool to the TrACE model is described throughout the analysis. Finally, the two tools are compared, and the research questions are revisited at the end of the chapter.

6.4.1 Analysis using the modified Assessment Tool

The modified Assessment Tool was used to categorise segments of conversation in relation to the sociocultural, personal and physical contexts, using indicator questions provided for each category. Responses to each question are meant to relate to a particular artefact or exhibit. This categorisation of conversational segments is not intended to distinguish individual conversations within what may be considered a continuous dialogue (in the case of Rachel and Adam), but only in terms of discrete references to the specified indicators. The categorisations are not mutually exclusive; some segments therefore correspond to multiple categories. The original and modified versions of the Assessment Tool appear in Appendices 1 and 2, along with the filled-in versions for each of the trails in this study, in Appendix 5. As a reminder, the areas covered by the Assessment Tool in the TrACE model are shown in Figure 6.4.

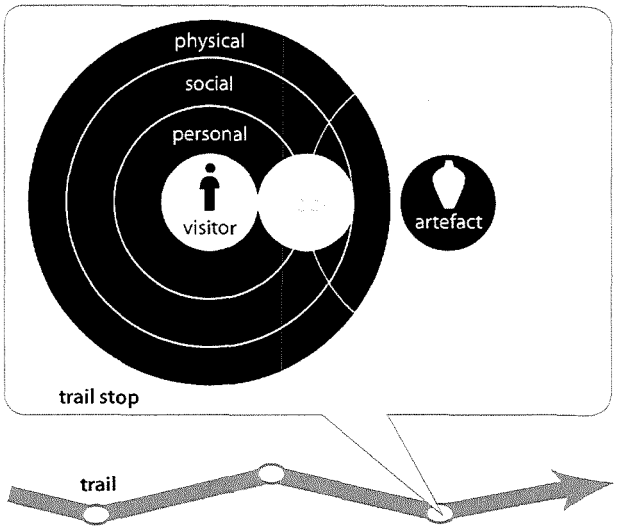


Figure 6.4 TrACE model with areas covered by the modified Assessment Tool highlighted in black.

Sociocultural context

In the Assessment Tool, the sociocultural context encompasses visitors' influences and interactions within their own social group, outside their social group, and in the broader cultural context. It contains indicator questions about visitor engagement, participation, collaboration and communication.

The first indicator question refers to ways in which the experience is engaging and thought-provoking, for example with connections to other experiences, elements of unpredictability, and information relevant to current issues. In this regard, most frequent in the trail of Rachel and Adam are connections to other experiences: for example Rachel's desire to see Monet paintings in relation to a television programme (Recording 1, 1:59), and her memory of a Giacometti poster she had while at university (Recording 1, 4:34). Elsewhere, she sees a 'famous Matisse' which appears on the cover of a Tate book she has at home (Recording 1, 8:11), and remembers a Rothko painting seen in a film (Recording 1, 13:34). The moving Moholy-Nagy sculpture they discuss in the excerpt in Section 6.3.3 reminds Adam of *Doctor Who* (Recording 2, 14:40). Besides cultural references, the pair make several references to previous and future visits, and these connections are triggered not only by artefacts, but by the layout of the collections generally (Recording 2, 3:12), and the view out the windows (Recording 1, 12:18). In his trail, Tim also provides a connection to another experience in

his trail, in his reference to a book he has read, which is triggered by an Easter Island statue (Recording 2). An example of a reference to the sociocultural context is shown in Figure 6.5.

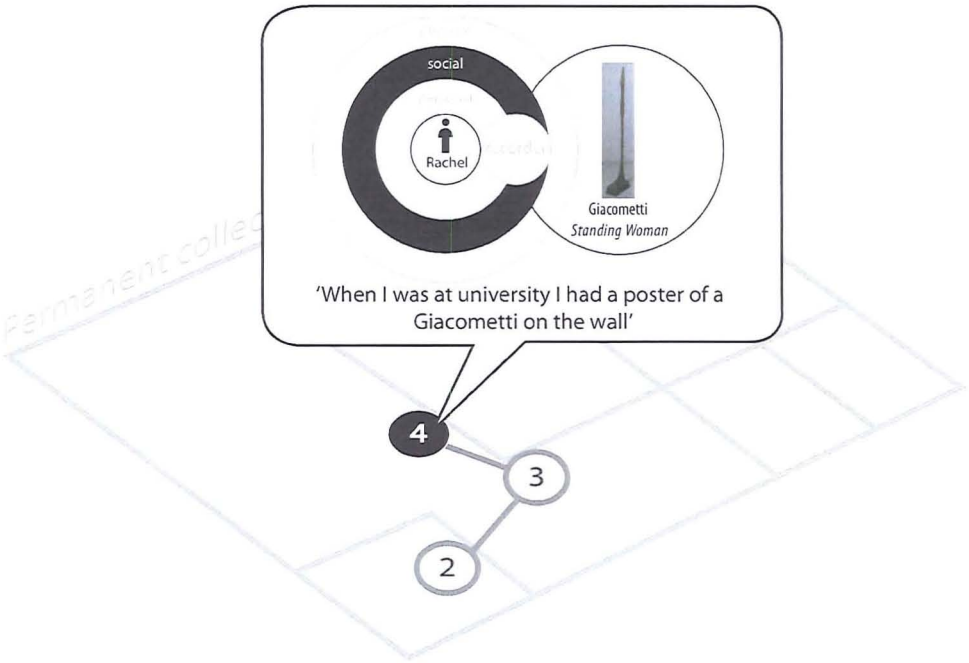


Figure 6.5 Example of reference to Rachel's social context (highlighted in the TrACE model in black), triggered by an artefact in her trail at Tate Modern.

Another indicator question in the sociocultural category is about how the visitors communicate, for example by sharing facts, talking about their history or identity, using explanations and questions. This is the most frequent category of data found in the trails of Keith and Tim — specifically, sharing facts from text labels by reading them into the audio recorder. But for Rachel and Adam, closed-ended questions are much more frequent; for example:

R: 'Is that a Jackson Pollock?' (Recording 1, 11:27)

A: 'Have you figured out what this room is for?' (Recording 2, 5:52)

R: 'What made that ball move?' (Recording 2, 13:49)

This illustrates a simple difference between a collaborative versus individual trail. For example, Tim asks an open-ended question: 'What would make you chop down the last tree?' (Recording 2). Of

course there can be no discussion or response since his presumed target for the question is separated by time and space, and mediated by the device; this raises a question about who such a question, and the trail generally, might be intended for. This point is discussed later.

Overall, the most relevant sociocultural indicators were connections to other experiences, elements of unpredictability, information relevant to current issues, open- and closed-ended questions, and basic information or facts. Other indicators in this section of the Assessment Tool relating to group collaboration and participation were not relevant.

Personal and cultural context

This section of the Assessment Tool evaluates visitor communication, dynamics, and personal and shared histories. This is termed the 'personal and cultural context' in the Tool, highlighting clear overlaps with the sociocultural context.

One indicator question refers to 'diverse personal and cultural histories,' including discussions about culturally-specific issues or contexts, links to particular communities, or gender roles. Tim, for example, is prompted by museum artefacts to talk about issues relevant to his own contemporary culture, such as environmental degradation and health care (Recording 2). Rachel and Adam compare a painting of a hooded figure to a rap music performer and 'hoodie'-wearing youths (Recording 1, 9:45); a Giacometti sculpture provokes comments about gender stereotypes (Recording 1, 5:00). One example of a reference to the personal context is shown in Figure 6.6.

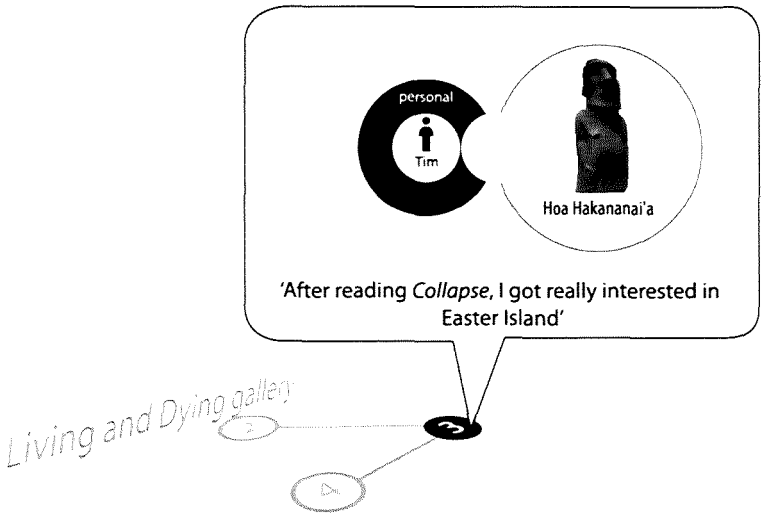


Figure 6.6 Excerpt from Tim's trail at the British Museum, with reference to his personal context highlighted (in black) in conceptual model.

Keith and Tim encounter other cultures — Easter Island and China — through artefacts. Rachel and Adam could similarly be said to encounter, for example, Germany in the 1920s in the *Bauhaus* exhibition, or Provençe through Monet's water lily paintings. But here a difference becomes apparent between 'pure' art museums such as Tate, and museums such as the V&A and British Museum, in which works (even contemporary ones, as in Keith's trail) are set in culturally and historically situated galleries. Broadly speaking, Keith and Tim might be said to experience (and implicitly accept) the colonial project in the neoclassical buildings they visit, which are filled with historical artefacts collected from other cultures. Rachel and Adam enjoy the Turbine Hall of Tate Modern, but similarly do not discuss the history of the former power station which houses the museum. Yet the artefacts displayed in art museums such as Tate — whether arranged by artist, era or theme, as discussed by the pair — are presented as being universal, and not exhibited to represent other cultures or time periods. None of the museums draws explicit attention to its broader cultural role, whether as colonial storehouse or arbiter of contemporary taste, and none of the participants mentions this.

Another indicator question in this category is about communications media used by visitors. It is taken as given that audio recorders are used, and in fact this is the only medium used in the study; other possible responses to this question include text messaging, drawing, and using artefacts to demonstrate concepts.

Overall, the most relevant personal context indicators were discussions about culturally-specific issues or contexts, current issues, and geographical areas. The least useful indicators were about group composition and modes of communication, while recognising that if different experience recording technologies were used, other modes of communication would become relevant.

Physical context

This section of the Assessment Tool evaluates the impact the physical environment has on visitors, how it accommodates the visitor group, and how they, in turn, use the space. In Rachel and Adam's trail for example, there were clear instances when they could be said to 'gather around,' as phrased in Question 3.2A. Visitor traffic flows and crowding (Question 3.1A) were mentioned by Tim at the beginning of his trail; and there were several instances in Rachel and Adam's trail in which crowds or queues (referred to in these environmental, not human, terms) changed the pair's planned navigation — these tended to occur at bottleneck points such as doorways, lifts and stairs, but also around particular artefacts (e.g., popular artworks such as Monet's water lily paintings). Gallery closures and maintenance works were also described. Navigation, therefore, can be seen as the intersection of the physical context with visitor activity.

As well as barriers, other visitors were sometimes viewed as objects of study themselves: for example, Rachel and Adam watched people in the Turbine Hall, and Rachel said, 'These girls down there are taking pictures of each other across the hall. Rather kind of abstract pictures' (Recording 1, 3:20). Other visitors also mediated the pair's encounters with artefacts:

> R: OK now I'm still looking at Giacometti, *Four figurines on a base*. 'Cause these other women were laughing at it, so I was kinda curious. (Recording 1, 5:53)

An example of a reference to the physical context is shown in Figure 6.7.

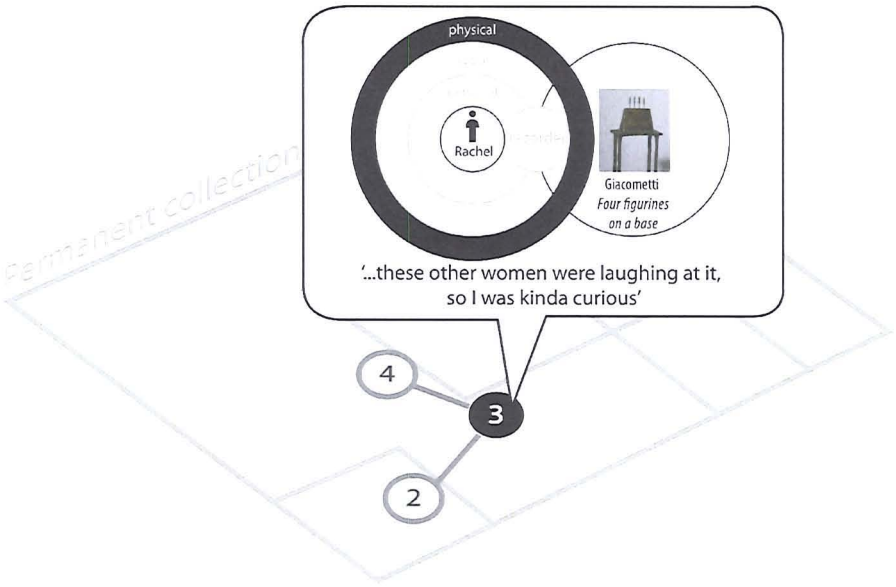


Figure 6.7 Excerpt from Rachel and Adam's trail at Tate Modern, with reference to the physical context highlighted (in black) in the TrACE model.

The boundaries between artefact and architecture can be seen to be blurred in the trail of Rachel and Adam, as for example when the pair discussed the Tate's 'Rothko room' (Recording 1, 13:34), or the Turbine Hall which was itself turned into one giant installation (Recording 1, 0:06). Rachel and Adam referred explicitly to architectural features such as floors (Recording 2, 2:49), windows (Recording 1, 12:18) and lighting (Recording 1, 13:47). However, it is reasonable to assume that what appears to be of most value in terms of their meaning making was not the locations but the artefacts. Reflecting back upon their visit, the pair might recall the crowds, the diversions, the floors and rooms they visited, and these may well have impacted upon meaning making. But it is the conceptual, not physical, links which are presumed to have more value — for example, Rachel's previously unknown link between Monet and Rothko paintings (Recording 1, 10:47), or possible links between artworks by Calder and Moholy-Nagy, or between Bauhaus architecture and that of Frank Lloyd Wright. A point for further investigation, therefore, is the distinction between physical and conceptual trails; this is investigated in the next study.

Studying group dynamics is both easy and difficult with audio data, based on the trails in this study: It is easy to tell when Rachel and Adam were close to the recorder and engaged in dialogue for example, but difficult to distinguish how or whether they were 'gathered around' an artefact or exhibit, as stated in Indicator Question 3.2. In the context of an audio trail as in this study, gathering

around, participation, and multivocality are effectively equivalent, since the activity undertaken is interpretation through dialogue. Yet this section of the Assessment Tool, like the others, belies its orientation to science museums, since 'gathering around' an artwork, as against a hands-on science exhibit, usually means clustering in front of a painting; participation in art museums is the act of interpretation, whether individual or shared.

Section 3.3 of the Assessment Tool is aimed at gauging reflection, indicating physical spaces in the museum which are particularly suited for it. This presupposes that the visitor group will sit down to do this, thus ignoring for example Schon's (1983) notion of 'reflection-in-action.' Rachel and Adam, for example, used a coffee break on the terrace overlooking the river for reflecting and planning — while standing (Recording 1, 21:10).

The physical context cannot be seen to end at the museum's walls any more than learning does, according to Falk and Dierking (2000). In Rachel and Adam's trail, windows prompted the pair to refer to the Thames, St. Paul's beyond, to London generally (R: 'It's a popular day to be wandering around London,' Recording 1, 12:53); and to the weather (R: 'Whoa. Looking grey out now,' Recording 2, 25:51). All of these instances can be seen as linked to the pair's shared personal context as well as the physical. Elsewhere are references to other physical places such as home, work, and other cities (A: 'He did one in New York, which was giant mushrooms,' Recording 1, 0:45).

There was a sense of accomplishment by the pair at covering a broad swathe of the museum:

> R: Well we've done part of floor three and part of floor four. And of course floor six, which is very important. Ready to wander back to Waterloo? Okay, we're going down the escalator. (Recording 2, 26.22)

This is a phenomenon described by Czikszentmihalyi and Harmanson (1999) in relation to tourists, who try to see as much as possible, and for whom seeing is equivalent to experiencing: they have lists of sites to visit and attempt to tick off as many as possible. While the activity of trail construction appeared to have constrained the visits of Keith and Tim (at least those portions which are recorded), Rachel and Adam tried to cover as large a portion of the museum as possible, just as their continuous recording detailed nearly every act of navigation and interpretation.

Overall, the most relevant physical context indicator was the effect of the physical environment on the visitors; accommodation of spaces for group participation and reflection were less important in this study.

The indicator questions in the Assessment Tool related to the physical context were relevant to the trails in this study, but again exposed overlaps with the personal and sociocultural contexts. The Assessment Tool was useful in drawing attention to personal, physical and sociocultural aspects of museum visits generally, and in specific encounters with artefacts. However, because the Tool was originally oriented to evaluating exhibits with regard to family learning in science centres, significant portions of it, even in modified form, were irrelevant to individual and paired adult visits to art and cultural-historical museums.

In summary, the Assessment Tool used in this section was useful in studying some aspects of context, but failed to fully account for technological mediation of visitors' encounters with artefacts. The Activity Checklist is intended to evaluate tool use in context, and is intended to complement use of the of the Assessment Tool; it is utilised in the next section of the analysis.

6.4.2 Analysis using the Activity Checklist

As described in the previous chapter, the Activity Checklist is grounded in activity theory, and is intended to draw the researcher's attention to relevant areas of tool use in context, specifically means and ends, the environment, learning/cognition/articulation, and the development of activity over time. A complete version of the Checklist appears in Appendix 3. Figure 6.8 shows the areas of the TrACE model covered by it.

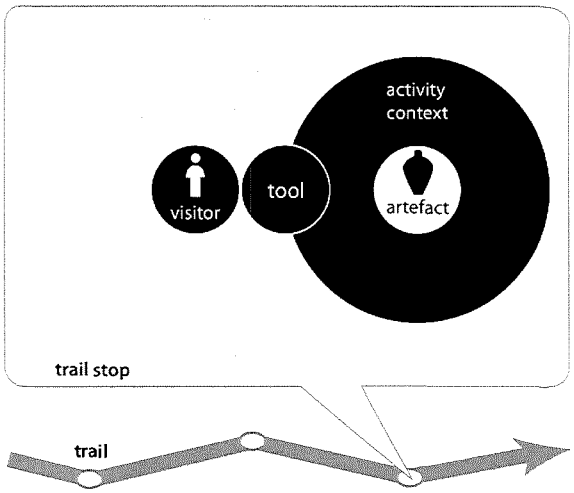


Figure 6.8 Areas of the TrACE model covered the the Activity Checklist, highlighted in black.

Means and ends

This section of the Checklist covers how a technological tool (audio recorder in this study) facilitates or constrains users' goals, and supports their activity generally. First, users' goals are identified and decomposed into sub-goals. Next, the criteria for achieving these goals are identified, along with conflicts and their resolution if any. Finally, the scope is extended up to include users' broader motives, and down to focus on particular actions and operations they carry out.

The stated goal of the activity in this study was to create a trail in a museum using a portable audio recorder. The general actions required for constructing a trail, regardless of technology, are navigating through the museum to artefacts of interest, and making a recording at each location. Since the visitors in this study were all experienced museum visitors, it is reasonable to assume they were familiar with the actions of navigating through museums generally, attending to artefacts, negotiating around the space and other museum visitors, and other social conventions of museum-going.

Sub-goals were not explicitly identified, and the visitors each interpreted the goal differently. Keith created a trail through a single museum gallery consisting of a small number of discrete, brief recordings, each containing mostly descriptive and location information about particular artefacts, with a minimal amount of personal interpretation. Tim interpreted the goal similarly, also creating a small number of discrete, brief recordings. Tim's trail similarly contained descriptive information, but much more personal interpretation, questions, and connections to external experiences, as identified

in the previous section; he also did not restrict his trail to a single gallery. For both Keith and Tim, trail construction therefore consisted of the sub-goals of creating single recorded segments at particular artefacts, with some amount of description and interpretation at each. Rachel and Adam interpreted the goal differently, creating an almost continuous recording as they navigated a large portion of the museum, containing not only artefact identification and interpretation, but the pair's navigational decisions and interim conversations. That navigation was foremost to trail construction is evident in Rachel's description at the end of the trail as 'our navigation through Tate Modern.' Sub-goals for the pair were thus to explicitly state their current, intended, and negotiated locations; to identify artefacts; and provide personal and shared interpretations.

Success in all three cases can be broadly defined as a trail consisting of one or more recorded locations and some degree of interpretation. The tool (recorder) facilitated this generally, but a technical problem on the iPod (time required for hard drive of older iPod model to spin up) resulted in the loss of some data at the beginning of recordings. In at least one instance this was important data which identified an artefact, and since no other types of data were collected, this might have resulted in a problem in reconstructing the trail later, had I not visited the gallery myself. However, for the visitors, this was not perceived as a breakdown in the technology at the time; if they had listened back to one of their recordings, they might have tried to resolve the conflict in successive recordings.

Rachel and Adam experienced no apparent recording problems. In fact, since they recorded continuously, at one point Rachel mentioned that she forgot she was recording. This may constitute evidence of internalisation of the task from the perspective of activity theory. While the pair recorded continuously as they traversed stairways and in between galleries, they stopped the recorder when at the cafe for a snack. Thus they included navigation in their definition of the activity, but not eating. They did, however, start recording again while still in the café, but only after eating, and this provided an opportunity for reflection and planning. Figure 6.9 shows an example of a reference to the means of trail construction (the recorder); note that the reference did not occur at an artefact, therefore only Rachel is depicted, along with the time in the trail recording that the reference was made.

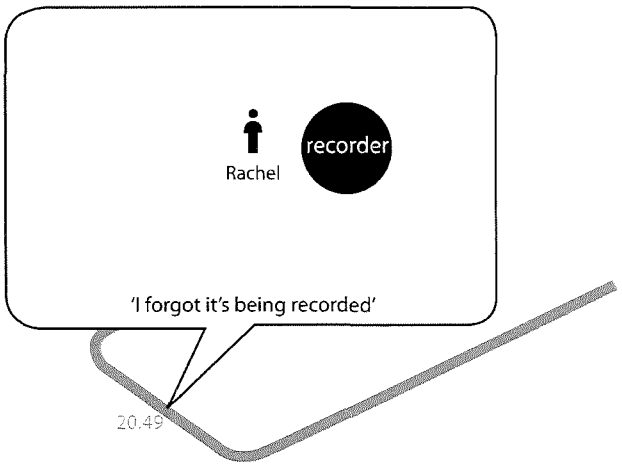


Figure 6.9 Excerpt from Rachel and Adam's trail at Tate Modern, with a reference to the mediating means (the recorder) highlighted; the time of recording is displayed along the path of the trail.

The underlying motives for the activity were partly the motives common to most adult museum visitors — for leisure as well as potential learning, as discussed in Chapter 2. In my original call for participants, I specified people who were already planning a museum visit, though the call may have acted as a push for those considering a visit, or even used as an excuse to make a visit. Keith was a fairly frequent visitor to the V&A; this may have influenced his decision to make a trail in the China gallery, as his trail indicates that his experience of that gallery was new. Tim was a visitor from out of town, though this was not his first visit to London; he had a hazily defined goal of seeing some sights while in town; the British Museum was free of charge, and it was near to where he was staying, as well as to where he collected the iPod from me. Rachel and Adam were frequent visitors to Tate (it is clear from the recordings that Rachel was a member), and they went to see a particular installation in the Turbine Hall (which was already gone however). All the participants knew me to some degree, and it is reasonable to assume they also participated in order to help with my research.

Moving down the 'object hierarchy' of activity theory, as described in Chapter 4, are (conscious) actions and (subconscious) operations. Given the brevity of the trails of Keith and Tim, it can be assumed that they did not internalise operational features of the iPod. Since they both regularly worked with technology to some degree, they may already have been familiar with the device, but given that Tim was in the computing field and did not definitively resolve recording versus pausing

on the device, this indicates he probably was not familiar with recording on the iPod in particular. Keith may have been, but the fact that his recordings were cut off indicates that he was not, at least, familiar with the audio recording capabilities of the device. On the iPod, audio recording is accomplished with a separate microphone/speaker attachment which is plugged in to the top; the recording menu is initiated when the attachment is plugged in, but if the device is powered off it reverts to the Main menu, in which case the user must navigate down two sub-menus to locate it. Therefore, both Keith and Tim had to carry out conscious actions when making recordings.

Rachel used her own recording device. Since she made no indication otherwise, it can be assumed she knew how to operate it reasonably well, and knew its interface and features. She also undertakes classroom research in her work, and uses the device in that context. She announced at the start of the second recording, 'Track 2' and gave the time of day, indicating that she read this information off of the machine, is familiar with basic audio recording conventions, and/or wanted to ensure that this information was clear on the recorded track.

There is not enough evidence to determine whether Rachel executed the recordings as conscious actions or unconscious operations, but it is notable when she realised she had forgotten she was recording (Recording 1, 20:49). Because she was recording continuously, Rachel did not have to think about performing the necessary actions on the device to start and stop recording. The recorder did not have a neck strap, thus she was likely holding it in her hand; Shortly after making the comment, it emerged that she was also carrying some sort of bag (Recording 2, 7:51), so it is possible she held both items in one hand, and was only conscious she was carrying *something*.

That Rachel may have internalised the action of recording the trail to some degree cannot be determined conclusively, since although she forgot she was recording and perhaps even carrying the recorder, narrating one's path through a museum is not a common activity. However, it is reasonable to assume that recording is more 'natural' when done with another person to converse with; this gave Rachel and Adam opportunities for dialogue, for example with the closed-ended questions mentioned previously. Conversations are also a much more common social practice in museums than a lone visitor talking into a recorder.

How the technological tool relates to the environment in which it is used is explored further in the next part of the Activity Checklist.

Environment

The definition of 'environment' in the Activity Checklist includes elements of the social as well as the physical context. It looks at rules, norms and procedures, how the tool integrates with other tools and resources, and how labour is divided in the environment. As with the other sections of the Checklist, this section is targeted at the intersections between contexts, tools, visitor and artefact, as shown in Figure 6.10.

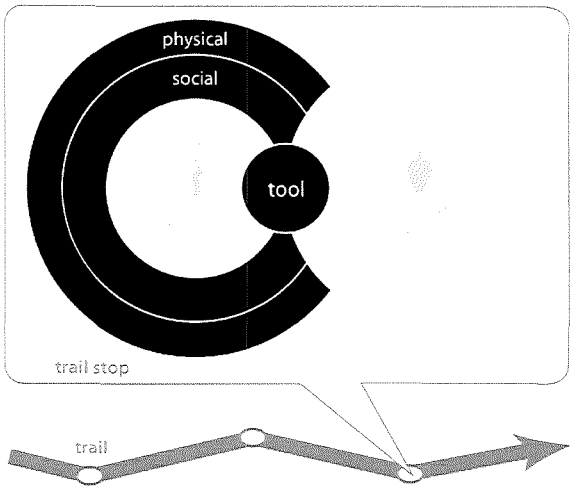


Figure 6.10 TrACE model, with areas covered by the Environment section of the Activity Checklist highlighted in black.

As discussed in Chapter 2, museum-going is a cultural ritual with social conventions, many of which are implicit, including encounters with artefacts which are usually quiet, contemplative and passive. As noted in Rachel and Adam's trail, visitors tend to look at artefacts attended to by other visitors, but not concurrently. For example Rachel attended to a nearby Jackson Pollack painting when there was a crowd around the Monet; she took a closer look at a Giacometti sculpture after other visitors were laughing near it. Groups of two or more visitors typically engage in hushed conversations, and individual visitors tend not to engage other visitors in dialogue. This was evident, for example, in the amount of free dialogue in Rachel and Adam's trail. Besides the fact that Rachel and Adam recorded continuously, it is reasonable to assume that neither Keith nor Tim engaged with other visitors in between their recordings.

From my own knowledge and experience of the three museums in this study, all tend to adhere to general museum social conventions, with the V&A somewhat less strict about enforcing norms such as silence, or the use of recording technologies in the galleries; the British Museum is the least technologically friendly. The presence of the recording tool — along with the trail construction activity linked to it — ran counter to social convention in all cases, prompting spoken monologues from Keith and Tim, and a running dialogue between Rachel and Adam (more so than would normally be expected). As discussed in Chapter 2, communication is related to ritual, and reality is reproduced, maintained, or transformed in rituals. As digital technologies increasingly pervade our lives they alter existing rituals and create new ones, according to Ling (2008). Evidence from this study suggests that technology can serve to undo some of the ritualistic aspects of museum visiting, such as silent contemplation. This is aptly illustrated by the conceptual model in Figure 6.10 above, as the intersection of visitors' social and physical contexts, mediated by the tool.

Due to my instruction to participants to capture artefact identification data, there was a clear relation between the recorder and other tools in the environment — specifically, text-based interpretation which was transferred to the device via the visitors' narration, along with their own interpretations. In the case of Rachel and Adam, this transference of data extended to navigational aids such as signage and the printed floorplan. Subjects' interpretations were thus mediated by the museum-provided tools, as well as by the handheld device. In the TrACE model, museum tools can therefore be separated from visitor-carried tools, as in Figure 6.11. Unlike portable digital technologies, museum-provided interpretive tools are, for practical purposes, inseparable from the physical context, and mediate visitors' encounters with the artefact's activity context.

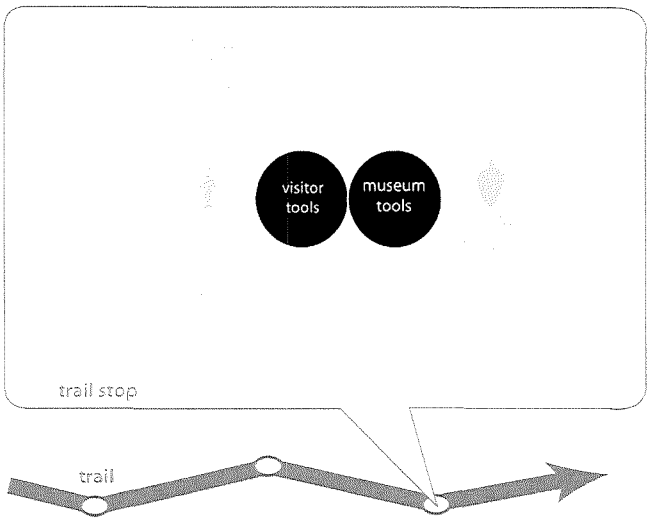


Figure 11. TrACE model, with museum-provided tools separated from visitor-carried tools, both highlighted in black.

A notable finding to inform my research questions about the trails concept and technological mediation, therefore, is that the construction of individual trail stops can involve a transference of information from one medium to another, or from the physical context (where museum interpretation is situated in the TrACE model) to the visitor's personal context (where portable digital devices are situated). When personal interpretations are added, this can be said to constitute personalisation of the trail; when such interpretations are negotiated in the form of dialogue (as in the case of Rachel and Adam), a trail can be characterised as both personalised and collaborative.

Regarding the division of labour, in the case of Rachel and Adam, Rachel maintained control of the tool, operating the controls and in most cases narrating, and prompting the dialogue. The division of labour was not relevant for the other two trails.

Learning/cognition/articulation

In the Activity Checklist, meaning making is tied to tool use, since the Checklist's primary purpose is technological evaluation. The Checklist looks at processes of internalisation and externalisation, and how the tool supports and mutually regulates these (with the assumption that a digital tool should support both). This section covers learning about the tool itself: any effort needed to operate it, and

breakdowns and their resolution. Since activity theory is grounded in social constructivism, it also pays attention to shared representations and the coordination of group activities. Thus, this section is targeted at the intersection of the personal and social contexts of the visitor, and the tool they carry, as shown in Figure 6.12.

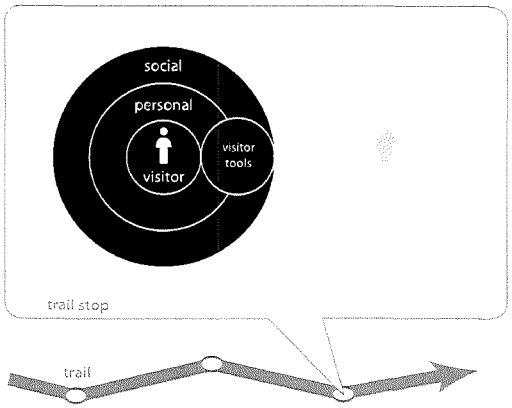


Figure 6.12. TrACE model with areas covered by the Learning/cognition/articulation section of the Activity Checklist highlighted in black.

According to Kaptelinin and Nardi (2006:271), digital technologies 'should support both internalization of new ways of action and articulation of mental processes, when necessary, to facilitate problem solving and social coordination.' As discussed, Rachel continued to conduct a spoken monologue and dialogue while forgetting that the tool was recording; this was partly because it was her own device, because she recorded continuously, and/or because she was also carrying a bag. None of the participants specifically mentioned the trail, aside from Rachel's comment at the end about the pair's 'navigation.' Only Rachel regularly used the tool for other means (classroom research), and the fact that she forgot she was recording her own voice suggests she does not normally use it for recording herself in museums. In the other two trails, the device was borrowed, and was linked only to the stated goal of trail construction. The device did not contain any explicit instructions (whether on the screen, in an audio recording, on a printed label or separate sheet), and participants did not convey a need for instructions, merely navigating the museum in a 'normal' manner, and recording at selected points. The device can therefore be said to have embodied the trails concept; it is possible that it therefore helped to internalise the concept.

Participants had to consciously select trail stops, and consciously externalise their thoughts into the device in a manner they would not otherwise do in a museum. In no cases did they require instructions on how to record audio, because both of the devices used were effectively single-purpose devices. Rachel's own voice recorder was designed for that purpose. In the case of the iPod, it is most commonly used to listen to music using headphones; here however, it required a separate microphone attached to the top in order to enable recording, and no headphones were loaned with the device. Thus it was physically configured to be, in effect, designed only for recording. Therefore, both devices, even without software designed to support internalisation or externalisation, implicitly supported both internalisation (of the trails concept) and externalisation (of individual and shared interpretations), through the design of the activity, not the technology.

The only known technological breakdown was, as discussed, the failure of the iPod to record the first few seconds of each recording. This was not perceived as a breakdown by the participants however, since it did not affect the recording process; thus it was not resolved.

How visitors' behaviour and meaning making developed over time is the subject of the final section of the Activity Checklist.

Development

This category of the Checklist draws attention to the transformation of concepts, goals and attitudes, as well as the activity itself and the environment, over time. The researcher looks for overlaps between internal and external, individual and collective aspects of the activity. In the TrACE model, time is represented as a trail between individual artefacts, with contextual and mediational aspects analysed at each encounter, as shown in Figure 6.13.

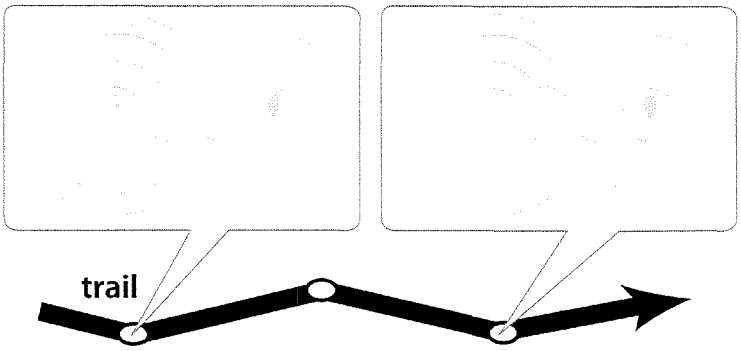


Figure 6.13 Time in the TrACE model is embodied by the trail itself, and analysed in terms of context and mediation at different points in the trail construction process.

Section 6.3 described how each trail unfolded over time. Keith and Tim's interpretation of the trails concept was close to the definition of trails in Chapter 3: as a series of linked, discrete 'learning objects.' There were some clues about how participants' understanding changed during the course of the trail. For example, Tim was initially frustrated at a lack of museum interpretation about a display of medicines; when he found and read a label, he recorded his pleasantly surprised reaction ('It's actually pretty cool when you look at it that way,' Recording 2). This constitutes a transformation of his understanding of the installation and the broader message it conveyed.

In activity theory, activity is regarded as goal-driven. Yet a goal is not currently represented in the TrACE model. A distinction must first be made between the goal of an activity — in this case the construction of a trail through a museum — and the object of activity. In activity theory, the object of activity is counterposed to the subject (in this case the visitor), as a projection of the subject's mind onto the world, and simultaneously a projection of the world onto the mind. In the context of museum activity this can be seen in the dialectic relation of visitors to artefacts, as discussed in Chapter 2; an artefact can be an object of activity itself, or can mediate the subject's understanding of some other object, such as the study of a particular topic. Goals, on the other hand, are consciously understood to direct activities toward an object, driven by underlying motives. Trail construction in this study was an explicitly goal-driven activity. Thus in Figure 6.14, 'goal' is shown as driving the activity of trail construction, which is in turn oriented toward encounters with artefacts and their contexts.

Figure 6.14 Portion of the TraCE model, with a trail represented as a goal-driven activity.

Regarding overlaps between internal and external components of the activity, the fact that Rachel forgot she was recording points to the tool as a site for both internalisation and externalisation, as discussed previously; she remembers she is recording when she looks down at the device. All the participants navigated the museum in search of artefacts of interest, and when they located them, they had to attend to the device in order to externalise their intepretations. When a recording was ended after an artefact encounter (as in the case of Keith and Tim), it can be assumed that the participant resumed navigation, and to some degree forgot about the device.

For Rachel and Adam, there were significant overlaps between individual and collective aspects of the activity. For example, Rachel switches from individual narration to dialogue when questioning Adam, or when negotiating plans. Yet the goal of trail construction is primarily Rachel's, and she drives the process, maintaining control of the recorder and doing most of the talking. The other two trails were not collaborative, and thus this aspect is not relevant to them. Taken together, the trails demonstrate that trail construction can be an individual or collective activity.

This concludes the analysis by the Activity Checklist. Next, the two analytical tools are compared, and the research questions revisited in light of the findings.

6.5 Comparison of the two analytical tools

In this study, the Assessment Tool and the Activity Checklist were complementary for analysis of the trails constructed by participants. The Assessment Tool drew attention to relevant aspects of visitors' contexts and the museum environment generally, highlighting links between artefacts and the personal contexts of visitors on the one hand, and broader cultural issues on the other; it also drew attention to ways in which the physical space of the museum influenced visitors' meaning making. The Activity Checklist focused on tool mediation and the development of activity; specifically, it helped illustrate that the device was closely linked to the trails concept, supporting both internalisation (of the concept) and externalisation (of interpretations), without bespoke software or

hardware. The Activity Checklist also pointed to links between the device and other resources such as text-based interpretation and navigational aids; it illuminated how the device related to rules and norms such as implicit social conventions; and it highlighted the goal-driven nature of trail construction.

Table 6.1 shows a comparison of the two analytical tools, using key characteristics which were identified in Chapter 2: context, the role of museum artefacts, technological mediation, and how each tool conceptualises and analyses visitor meaning making.

Key characteristic	**Assessment Tool**	**Activity Checklist**
Context	Divided into personal, sociocultural, physical	Focuses on physical and social; personal context is related to goals and object hierarchy
Role of museum artefacts	Seen as part of physical context	Not accounted for
Technology mediation	Not accounted for	Tool mediates goal-oriented activity
How learning is conceptualised	Related to overlap between contexts	Related to technology
How meaning making is analysed	In dialogue within visitor group; in snapshots	Observed in tool use; in development of activity

Table 6.1 Comparison of analytical tools in terms of context, role of artefacts, mediation and meaning making.

Based on the comparison, it can be seen that each tool illuminates different aspects of visitor meaning making: the Assessment Tool separating context into three aspects, and conceptualising meaning making in the overlaps between them; the Activity Checklist focusing on how technology is used in context, and locating meaning making in the intersection of visitor and tool. This comparison provides justification for integrating relevant aspects of the two tools into the TrACE model, which is itself shaped into a tool for analysis in the next section, for use in the next study.

6.5.1 An elaboration of artefact contexts

The modified Assessment Tool highlighted the value of identifying separate physical, personal and social contexts of visitors. Evidence was provided for the overlap of different spheres of context, and for the bridging of visitors' and artefacts' contexts, mediated by the technology. The Assessment Tool, in drawing attention to links between artefacts and other cultures for example, enables a richer description of the 'activity contexts' of artefacts. As discussed in Chapter 4, Kaptelinin (2008), as well as Pierroux, et al (2007), define activity contexts as the original context of the artefact's creation and use. Based on the trails constructed in this study, artefacts could be said to have their own separate 'personal,' 'social' and 'physical' contexts, just as visitors have.

An artefact's personal context can be considered to consist of the individual history of its creation, use, collection, preservation and display — for example in Tim's recording about inscriptions on a set of Chinese temple bells. An artefact's social context is the historical social and cultural conditions in which it was used; Tim wondered about such historical circumstances with regard to the inscribing process. And artefacts exist within the physical context of the museum gallery, where they are encountered by visitors. Thus, artefact contexts could be represented in the same manner as for visitors, as in Figure 6.15.

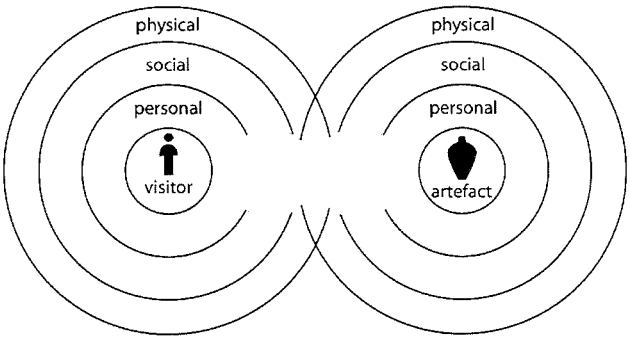


Figure 6.15. Visitor and artefact, both depicted with separate notions of context; they share the same physical but not social or personal contexts.

When curators create exhibitions, they typically seek to *re-contextualise* artefacts — in other words, place multiple artefacts into a shared social context, within the physical space of the gallery, with interpretative materials providing linkage. Each artefact retains its own 'personal context' or individual history. Thus, an exhibition of artefacts can be depicted as in Figure 6.16.

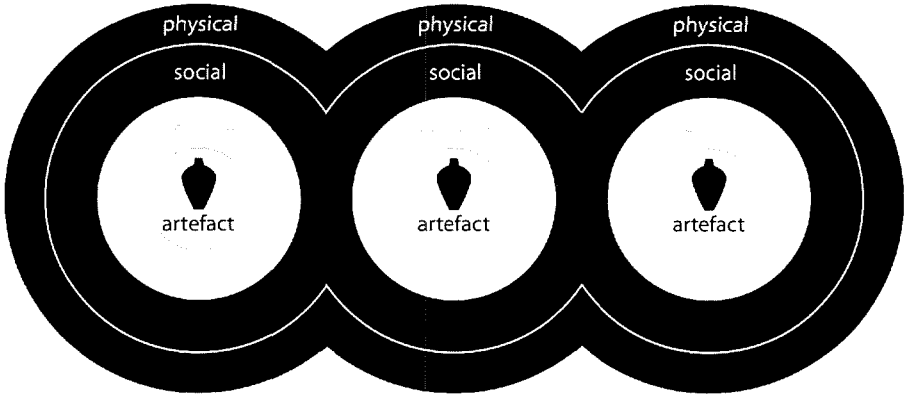


Figure 6.16 Conceptual representation of an exhibition, defined as multiple artefacts in a shared physical and social contexts (highlighted in black), but retaining their individual personal contexts.

Since this thesis focuses only on visitors' in-museum encounters with artefacts, the physical context can be considered to be fixed to individual artefacts. Visitors do not carry their own physical contexts with them, but move from one place to the next. Falk and Dierking (2000) equate the physical context with the museum as a whole. Yet associating the physical context with an individual artefact opens the possibility of encountering artefacts in different physical contexts within a single museum — for example in different galleries, as Tim, Rachel and Adam did. Thus, Figure 6.17 shows a further revised TrACE model, with the sphere of physical context removed from the subject and fixed to the artefact.

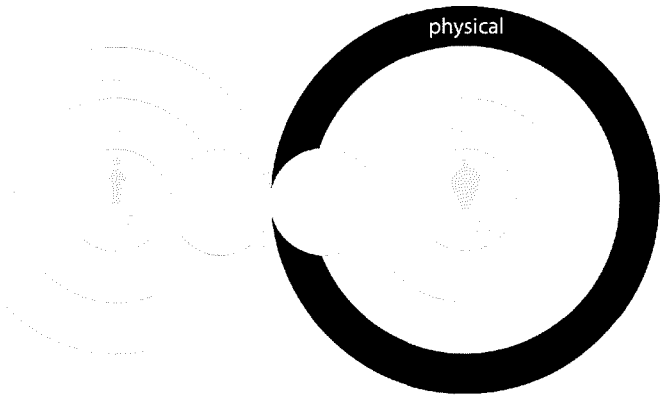


Figure 6.17 TrACE model, depicting physical context (highlighted in black) fixed to artefact.

6.5.2 Bridging contexts

When a visitor encounters an artefact in its physical context, if she attends to any associated interpretative materials then she may penetrate the artefact's social context as well — in other words, the underlying concepts or themes which curators have used in creating the exhibition — as when Rachel was prompted to compare the Rothko and Monet paintings. Socio-cultural information about artefacts, including their relation to other artefacts and their cultural contexts, is more commonly found in museum interpretation at the V&A and British Museum, where artefacts are meant to illustrate broader cultural and historical stories, as against 'pure' art museums such as Tate Modern, where the personal 'aura' of the authentic original artefact is valued above all; the example of Rachel just cited related to painting technique. However, Rachel and Adam nonetheless made connections from the artworks at Tate to other experiences (such as television programmes), demonstrating that such sociocultural links are one way in which visitors construct meanings from artefacts, even when museums do not provide such links.

While basic information about an artefact can be considered its 'personal context' as defined above, merely repeating this information into a recorder does not constitute bridging or penetrating this sphere of context; the artefact must link with a visitor's own personal experiences or interests. For example, a Giacometti sculpture links to Rachel's time at university; this linkage is prompted merely by encountering a work by the artist, and not necessarily by the particular features of the artwork itself. By contrast, a photograph reminds Adam of Rachel's block of flats; this is a purely aesthetic connection. But both examples relate to the pair's shared personal context, and to the personal contexts of the artefacts, as defined above as identification information as well as physical features. Therefore, both can be said to constitute bridging the artefacts' personal contexts. In a similar sense, a visitor could engage with an artefact's aesthetic qualities without apprehending its surrounding social context; possibly even neglecting the physical context as well, if engagement is so complete. In such cases, a subject could be said to go 'through' the social context directly to the personal context of the artefact, linking it directly to his or her own personal context. To illustrate the bridging of personal contexts, the Giacometti encounter from Rachel and Adam's trail is shown as an example in Figure 6.18. In this case, describing the encounter as a bridging of personal contexts illustrates it more richly by relating it to the artefact as well as the visitor, in keeping with a constructionist epistemology as described in Chapter 4; previously it was framed by the Assessment Tool only as a link with Rachel's social context (as shown in Figure 6.4).

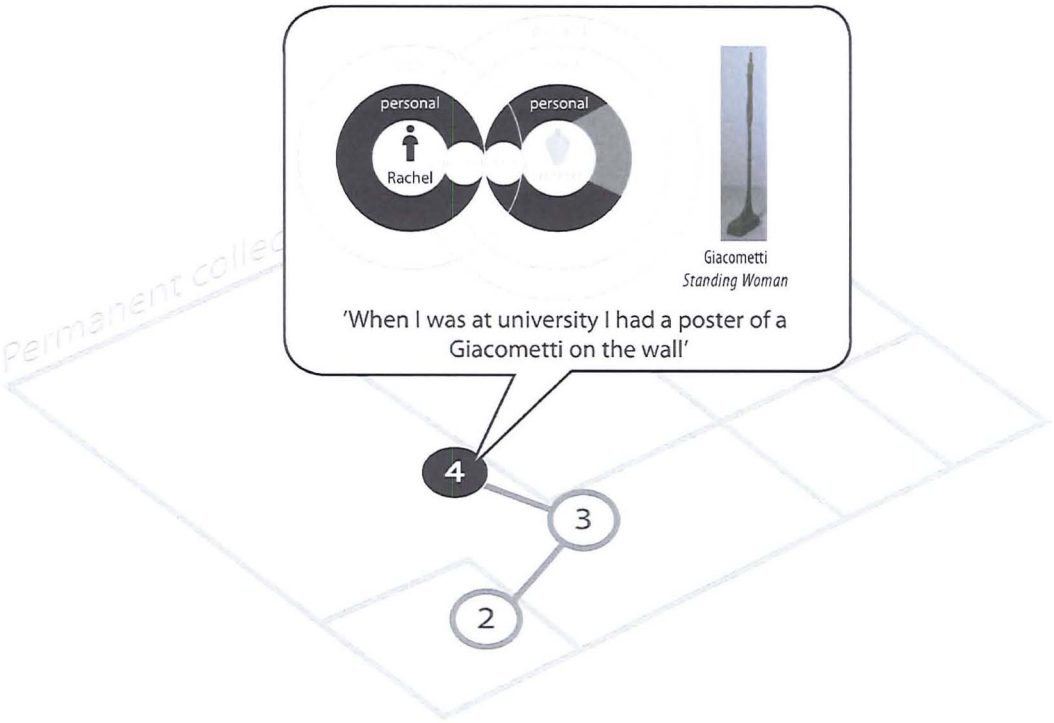


Figure 18. Example of bridging of personal contexts of visitor and artefact in the revised TrACE model, from Rachel and Adam's trail at Tate Modern.

6.6 Revisiting the research questions

The purpose of this study was to investigate participants' conceptualisation of trail construction through 'experience recording,' to use Peterson and Levene's (2003) term, specifically through the use of portable digital audio recorders. It provided initial data to address the three research questions, each of which is revisited below.

Research Question 1: (How) can visitor-constructed trails support meaning making in museums?

This study did not use a pre-designed structure for trail construction, instead investigating how adult visitors interpreted the term 'trail' in the context of an average museum visit. The trails constructed in the study were interpreted by participants in this emergent sense — as a result of navigation between artefacts of interest, through the identification of artefacts, and with the capture of additional descriptive and interpretive (qualitative) information provided by both the museum and the visitors. It is at the meeting between museum and visitor interpretation, at the site of artefact encounter, where visitor meaning making can be seen (or heard in this case). In the TrACE model this occurs in the centre, where visitor and artefact contexts meet and are bridged, mediated by visitor-carried and museum-provided tools, as shown in Figure 6.19.

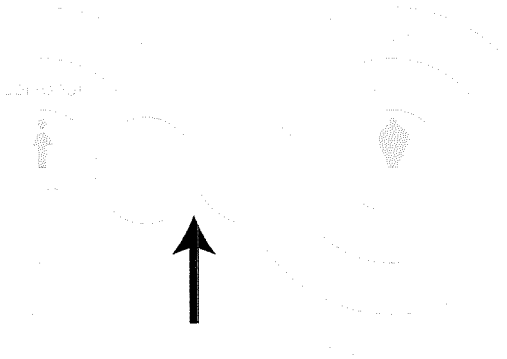


Figure 6.19 Visitor meaning-making with individual artefacts is located in the centre of the TrACE model, in the mediated encounter between visitor and artefact, as indicated by the arrow.

From the findings in this study, navigation was defined as the intersection of the physical context with visitor activity. However, trails, as defined by Peterson and Levene (2003), are meant to locate meaning making not with individual 'learning objects,' but in the links between them. While the concept of a trail as a visitor-constructed, technology-mediated product helped shape participants' articulated interpretations into a product through their activity, the participants did not make many explicit links between artefacts. This was primarily because the instructions did not specify that a trail should have an underlying concept or theme, the intention being to obtain a baseline understanding of how visitors would interpret the term 'trail.' If meaning making is defined as model building (Sotto, 1994), pattern construction (Falk and Dierking, 2000), or specifically in the links between individual

artefacts (Parry, 2007) in the form of trails (Peterson and Levene, 2003), then this issue requires further research. Subsequent studies therefore focus on the deliberate shaping of a visitor-constructed trail into a coherent product, centred on a particular topic.

Both types of trail constructed in this study (discrete stops versus continuous narration) proved useful for different purposes: Shorter trails enabled participants to focus on specific, selected artefacts; while a longer recording provided more research data for studying the development of activity over time, including details of navigation, and conversations between exhibits. In neither case did participants have significant problems with the trails concept or the construction process. However, while the research value of the trails was clear, and while the ways in which trails supported visitors' meaning making were detailed — the 'how' in this research question — the general usefulness of the trails to the participants was not resolved. As this study targeted visitors' interpretation of the trails concept, the next two studies focus increasingly closely on the uses of trails for those who construct them (and others), as well as the ways in which they support museum meaning making through linked artefact encounters.

Research Question 2: How do portable digital technologies mediate and support trail construction?

This study investigated the usefulness of audio recording as a means of mediation, as well as a method of data capture. In terms of mediation, the device was seen to effectively embody the trail construction activity and facilitate internalisation the trails concept, while simultaneously prompting externalisation in the form of articulated descriptions and interpretations of artefacts. As discussed, it countered some of the ritualistic aspects of museum-going, such as silent contemplation of artworks. As discussed in Chapter 4, the active mental construction of meanings has been difficult to study in museums, due to visitors' outwardly passive encounter with artefacts. This study shows that a portable digital device such as an audio recorder — when linked to a goal-directed activity such as a trail — can prompt visitors to articulate links between artefacts and their own personal and social contexts, which was defined by Falk and Dierking (2000) and Hooper-Greenhill (1999a) as one of the primary ways visitors make meanings in museums.

The modified Assessment Tool, having been originally designed to evaluate museum exhibits, did not account for visitor-carried mediating technologies, but the Activity Checklist drew attention to internalisation and externalisation prompted by the device, as well as links between the device and

other resources such as text-based interpretation and navigational aids; and the relation of the device to museum rules and norms. The Checklist, however, did not explicitly focus on 'double mediation,' defined by Pierroux, et al (2007) as the mediated study of a particular topic, through both technological tool and artefact. However, the analysis using the Checklist, when combined with visitors' connections to other experiences and other cultural contexts as identified by the Assessment Tool, can be seen to illuminate this issue. Indeed, meaning making was found to be mediated through the audio recorder, as well as by museum interpretation, and the artefact. Thus, the term 'multiple mediation' may be more suitable than 'double mediation.'

Although the digital audio recorders used in this study were small and generally easy to use, they required transferring the audio data to a computer afterwards. While audio data could remain on the recorder, carried across physical contexts, and played back at will, it could not be easily edited, shared or annotated without transfer to a computer. Thus, the next study employs a visitor-carried tool with built-in communications and data transfer capabilities: the mobile phone; this also provides the opportunity to study other modes of communication (text and images) for trail construction.

Research Question 3: What is an appropriate model for the design and analysis of technology-mediated museum trails?

The TrACE model developed in Chapter 4 was useful for representing and analysing encounters between visitors and artefacts during the trail construction process, including aspects of context, and mediators of the encounters. The representation of mediators in the model was split to differentiate visitor-carried tools and museum-provided interpretive tools, thus depicting double, or multiple, mediation. Personalisation of a trail was defined as a transference of data from the physical context (where museum interpretive tools are situated) to the visitor's personal context (where portable digital technologies are situated), during the process of construction of personal interpretations. The model was additionally valuable to visually depict relations within and between the two analytical tools used in this study. A goal was added to depict trail construction as a goal-driven activity, from the Activity Checklist. The contexts of artefacts were enriched by adding distinct 'personal,' 'social,' and 'physical' contexts; the physical context was shown to be fixed to artefacts, not visitors.

The TrACE model is therefore used as an analytical tool hereafter, and relevant indicators from the Assessment Tool and Activity Checklist are integrated into the model, as shown in Figure 6.20. Focusing first on the Assessment Tool, from the personal context the section on 'modes of

communication' is associated with the visitor-carried tool in the model, since the focus in this thesis is on the device as mediator. The section of the Assessment Tool about 'performing tasks' is situated in 'Development' in the model, and visitor interpretation related to current issues and other cultures is placed in visitors' social context. This leaves the personal context in the TrACE model focused on reflection and connections to other experiences. As discussed in Section 6.5.1, the physical context is now considered to be fixed to artefacts, and includes the effects of lighting and architecture as well as how the space accommodates the subject(s) — all in relation to individual artefacts.

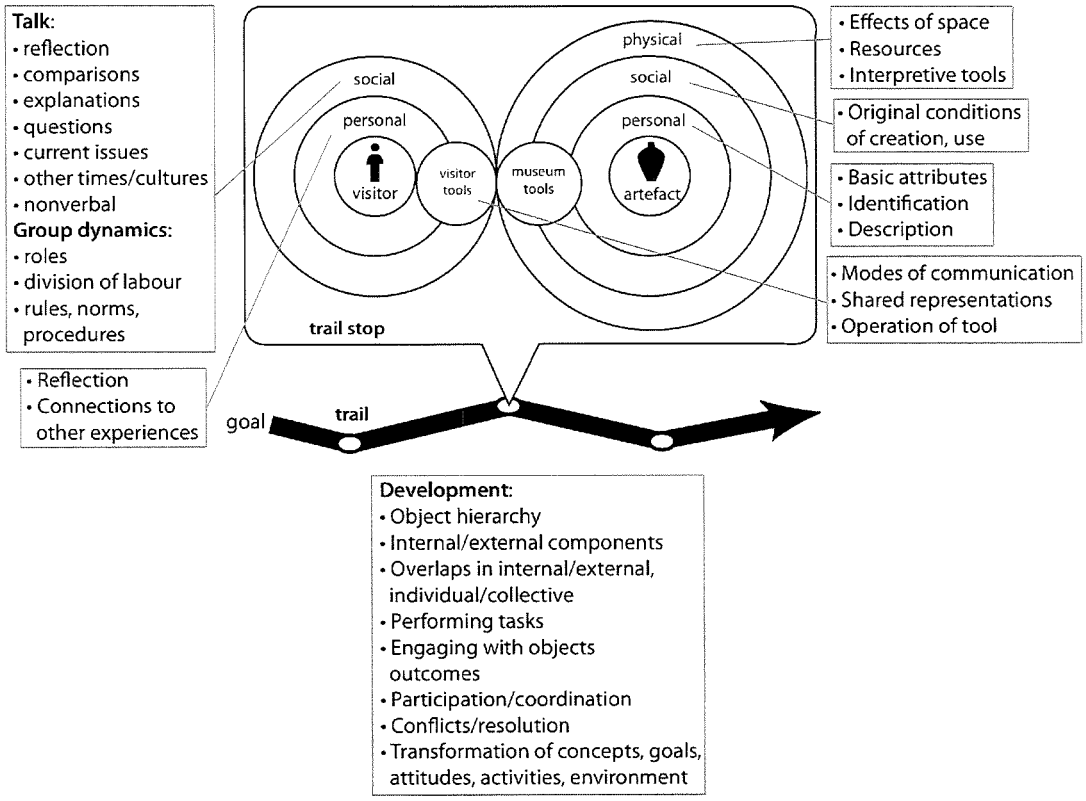


Figure 6.20. Version 2 of TrACE model, showing indicators from Assessment Tool and Activity Checklist added.

Regarding the Activity Checklist, 'goal' has now been added to the TrACE model, and as in the Checklist, the explication of goals and sub-goals should be a first step in analysis. How goals are attained, including conflicts and resolution thereof, is studied as the activity develops. The 'Environment' section of the Activity Checklist is associated mostly with the physical context of the

artefact in the model, including mediating tools such as museum-provided interpretation, as discussed. The division of labour, and rules, norms and procedures have been moved to the social context of visitors however. While these exist in relation to the physical context as well, they are essentially social conventions and are treated as such; as discussed in Section 6.4.2, the 'Environment' section of the Activity Checklist includes aspects of the social as well as physical context.

Regarding 'learning/cognition/articulation' in the Activity Checklist, since the study of internal and external components of activity, and issues around the coordination of group activity, must be studied over time, they are placed in the 'Development' section of the TrACE model. The 'Development' section of the Checklist is also situated there, and includes overlaps between internal/external; individual/collective aspects; and the transformation of concepts, goals, attitudes, activities, and the environment over the course of the activity. Since a trail consists of links between artefacts, the activity (that of trail construction) is depicted, as before, as an arrow linking multiple artefacts, and analysis involves the degree to which a trail helps to bridge the physical, social and personal contexts of subjects and artefacts, at and across individual artefact encounters.

Thus, the TrACE model views meaning making as occurring between visitors' and artefacts' personal and social contexts, thereby grounding it in social constructivism; meaning making is depicted as being mediated by tools, as in activity theory; and it takes shape through goal-oriented activity aimed at the construction of a concrete product, in keeping with a constructionist pedagogy. This model adds contextual richness to the roles and contexts of artefacts, which builds on the work of Kaptelinin (2008) and Pierroux, et al (2007), to flesh out what they term the 'activity contexts' of artefacts.

Methodologically, there was no significant difference in the analysis in this study between having indicator questions or a checklist; the former were more specific, but many went unused. Each indicator or checklist item from the respective tool has thus been placed diagrammatically onto the TrACE model in Figure 6.20 above, and for analysis, the activity, as observed and recorded, is compared against the model. Further methodological issues encountered in this study are discussed in the next section.

6.7 Methodological issues

The trails constructed in this study utilised only audio recording to collect data from visitors; the data included individual recordings at artefacts of interest, plus in the case of Rachel and Adam, additional

dialogue during the visit. In both types of trail, evidence was found to demonstrate visitors' changing understanding over time, but the longer audio recording was more useful for research, while the shorter recordings served to focus the trail itself on particular artefacts of interest to visitors. The two types of data could be explicitly separated, with discrete segments captured by visitors for use in trails, and continuous audio of the activity recorded only for analysis. This data could additionally be supplemented with *in situ* and/or follow-up interviews; these would have been useful, for example, to assess why the participants made some of the decisions and interpretations they made during the activity.

In addition, other methods and media could aid in analysis of the activity. For example, direct and mediated observation of the trail construction process would help to situate and analyse interactions between people, artefacts and the environment, showing for example how visitors use and understand tools, populate the physical context, and use gesture and other nonverbal communication. Enabling visitors to capture images, video or text as part of a trail would provide additional ways for them to construct interpretations of artefacts. In addition, many digital devices can keep a detailed quantitative record of captured data through log files, and other functionalities such as the automatic transfer and visualisation of trails may yield a rich additional source of data.

The Activity Checklist highlighted the goal orientation of trail construction. The addition of a more explicit goal and topic is hypothesised to focus trails and facilitate links between artefacts, presumably resulting in trails with more coherent narrative structure. Thus, the study detailed in the next chapter is conducted with schools, for which museum visits are usually tied to particular topics. In addition, as the aim of this thesis is to investigate the trails concept across different visitor and museum types, the next case study involves primary school students constructing trails at a botanic garden, using a mobile phone-based system to capture multiple media for use in trails. A larger sample in the next study also addresses a limitation of the study in this chapter: only a few, self-selected participants made trails and interpreted the trails concept variously; a larger sample, in a more focused activity would produce more conclusive, and generalisable, findings.

6.8 Conclusion

This chapter described a study of how adult visitors interpreted the trails concept, how they interpreted individual museum artefacts in the context of trail construction, and how this activity was

mediated by audio recording technology. The analysis revealed the following issues in relation to the research questions:

Research Question 1: (How) can visitor-constructed trails support meaning making in museums?

- The trails constructed in this study were interpreted by participants as resulting from navigation to, identification of, and interpretation of artefacts of interest; however participants did not make many links between artefacts. Would the introduction of a topic or theme to a trail facilitate these?
- Whom is a given trail intended for — a teacher, the researcher, peers, or the visitor him or her self? Addressing this might clarify the form and amount of data captured.

Research Question 2: How do portable digital technologies mediate and support trail construction?

- Handheld tools, as distinguished from museum-provided interpretive tools, can embody the trails concept and provoke visitors to externalise their interpretations. Might making this embodiment more explicit better facilitate trail construction?
- Museum-provided tools are also seen as mediators; how might the introduction of a topic or theme illuminate the process of double or multiple mediation?
- Audio was useful for prompting reflection and studying group dynamics, but the two methods used in this study could be separated: short clips captured by visitors, longer audio by the researcher for studying development over time.
- Audio could be supplemented with other media: for visitors these might help construct interpretations in different ways; for the researcher, direct and mediated observation would help illuminate tool use and the development of activity.

Research question 3: What is an appropriate model for the design and analysis of technology-mediated museum trails?

- Trails are seen as a goal-oriented activity; how might an explicit goal (construction of a trail around a particular theme or topic) affect the visit?
- How will it affect data analysis to separate artefact contexts into personal, physical and social?
- The physical context in particular requires further study: it is seen as fixed in relation to artefacts, but as shown in this study, the addition of other visitors as environmental features

make this context fluid. Additionally, it was not seen to be bounded by the walls of a particular gallery or the museum generally; and the boundaries between artefact and architecture can be seen to be blurred in an art museum — might this also be the case in other museums?

- Visitor-carried tools and museum-provided tools are considered part of different contexts; what are the relations between them?

These issues are explored in the study described in the next chapter, which expands the scope of trail construction in various ways.

Chapter 7
Study of trail construction by primary students at a botanic garden

The study described in the previous chapter provided a baseline understanding of how adult visitors interpreted the trails concept and construction process during casual museum visits. It also investigated how handheld technology — specifically digital audio recorders — mediated the activity, and it informed the development of the TrACE conceptual model for analysis, with the aid of two analytical tools. The issues raised in the previous study are explored in the study described in this chapter as follows:

Research Question 1: (How) can visitor-constructed trails support meaning making in museums?

- The trails constructed in the previous study were interpreted by informants as the result of navigation to, identification of, and interpretation of objects of interest. However, informants did not make many links between artefacts; as described in Chapter 3, coherent links between individual artefacts are what lend value to trails. Therefore in this study, a topic is introduced to the trail construction activity in order to facilitate such links.
- The question of whom a given trail is intended for was raised in the previous study; it is addressed here by situating trail construction in the context of a school visit, in which trail construction is part of student research for teacher-assessed products.

Research Question 2: How do portable digital technologies mediate and support trail construction?

- In the previous study, portable digital technologies, as distinguished from museum-provided interpretive tools, were found to embody the trails concept, and provoked informants to externalise their interpretations. This embodiment is made explicit in this study by the use of a purpose-built technological tool designed for a form of trail construction.
- Museum-provided tools are also seen as mediators. The introduction of a topic in this study is intended to further study multiple mediation.
- Audio was useful in the previous study for prompting articulation and studying group dynamics, but the two disparate approaches used by informants previously are separated in this study: short clips are captured by informants for use in trails, and longer audio is recorded only by me, for the purpose of studying the development of activity over time.
- To broaden the investigation of technological mediation of trail construction, other media (images and text) are investigated as well; for me as the researcher, direct and mediated observation are introduced as methods to help investigate tool use and the development of activity.

Research question 3: What is an appropriate model for the design and analysis of technology-mediated museum trails?

- Trail construction was re-conceptualised after the previous study as a goal-oriented activity; here a goal is framed around the construction of a trail on a particular topic.
- Artefacts' contexts were divided into personal, physical and social contexts after the previous study, and this separation of artefact contexts is validated in this study.
- The physical context in particular was seen as fixed in relation to artefacts, but fluid when other visitors were regarded by informants as environmental features. Additionally, the physical context was not seen to be bounded by the walls of a particular gallery or by the museum generally, and the boundaries between artefact and architecture were blurred in an art museum. The physical context therefore receives further attention in this study, in a very different museum type.
- Visitor-carried tools and museum-provided tools were considered part of visitors' and artefacts' contexts respectively; the relations between them are explored further in this study.

This study takes the findings from the previous study about the trails concept, tool mediation, and the conceptual model, and applies them to a visit by primary school students to a botanic garden. This

study employs a mobile phone-based learning system which includes image and text capture as well as audio capture. This is intended to link the trails concept more explicitly to the technology, and to investigate a broader range of media than in the previous study (see Section 7.1.3). Thus the specific aim of this study is to investigate trail construction in a more structured context: with students studying a particular topic in a science setting, using a technology custom-designed for structuring student visits to museums, while also providing media other than audio for use in trails. This study tests the validity of the TrACE model iterated in the previous study, particularly with regard to goal orientation and the structure of trail construction activity; and with regard to artefact contexts, with particular emphasis on the physical context.

7.1 Research design

7.1.1 Setting

This study was conducted at Kew Gardens, a large botanic garden in London. This provided an opportunity to investigate the trails concept in a science context, in a series of school visits. As described in Chapter 2, botanic gardens conform to my definition of museums, being places of semi-formal public learning with large collections of 'artefacts' (plants in this case) and accompanying interpretative information. As in other museums, the artefact are collected, preserved, exhibited and interpreted, and Kew in particular is strongly focused on education. Trails, as described in Chapter 3, are regarded as particularly suited to large, nonlinear information spaces. Kew provides ample scope for this type of activity, with many themed exhibit areas (analogous to museum galleries), each in turn containing many individual plants, generally grouped by taxonomy or theme (for example tropical plants, succulents, food plants). There is also a museum proper, although it was not used in this study; this study took place in a classroom in the museum building, and in the outdoor 'Order Beds'.

This setting provided a sharp contrast to the museums in the previous study, while also posing challenges for the conceptual model regarding the extent to which plants can be considered artefacts, and the role of an outdoor setting as a physical context.

7.1.2 Sample

Four primary school classes (all Year 5 / Key Stage 3 / age 9-10) of approximately 30 students each made day-long visits to Kew Gardens to study food plants, in June 2006. Schools were chosen as a visitor group for this study because they normally undertake goal-directed activities in museums along particular topics, and this study investigated trails' support for such visits, as part of the overall aim of this thesis to investigate trail construction as a meaning making activity across different types of museums and visitors. The schools were enlisted as part of the 'Plant Science Gardens' project, which is described in Section 7.3.1.

Each class visited Kew on a different day. In addition to myself, present at each trial were two Kew education staff (hereafter identified as E1 and E2); three to four adult helpers with each class (usually parents) in addition to the teacher; (hereafter A1, A2, etc); and Dr Sue Johnson, another researcher from the Institute of Education in charge of the 'Plant Science Gardens' project. The adults were all considered as subjects of the investigation, and studied in terms of how they supported and interacted with students.

7.1.3 Technology used in this study

To help link the trails concept explicitly with the technological tool, I decided to use the My Art Space system for this study. In contrast to casual adult visits, school visits often target a particular gallery and/or topic, often with explicit goals and outcomes; introducing a technological tool (phones) and conceptual tool (trails) was considered suitable to support their existing activities and goals. As described in Chapter 3, My Art Space (developed independently of this research by a private company) consists of mobile phones with proprietary software designed specifically to support school visits to museums. In the system, a goal or research question is set by a teacher before a visit, and students use the phones to capture evidence to support their responses or hypotheses, in the form of audio, images and text, all of which are automatically sent to a web site where students can then shape the data into a coherent presentation. The captured data is placed in a linear, time-based format which is, in effect, a trail. The system has been trialled by schools in art and history museums (Moussouri and Fakatseli, 2009; CETADL 2006a, 2006b), but had not previously been used in a science setting, nor explicitly for trail construction. A screenshot of the My Art Space web site is shown in Figure 7.1.

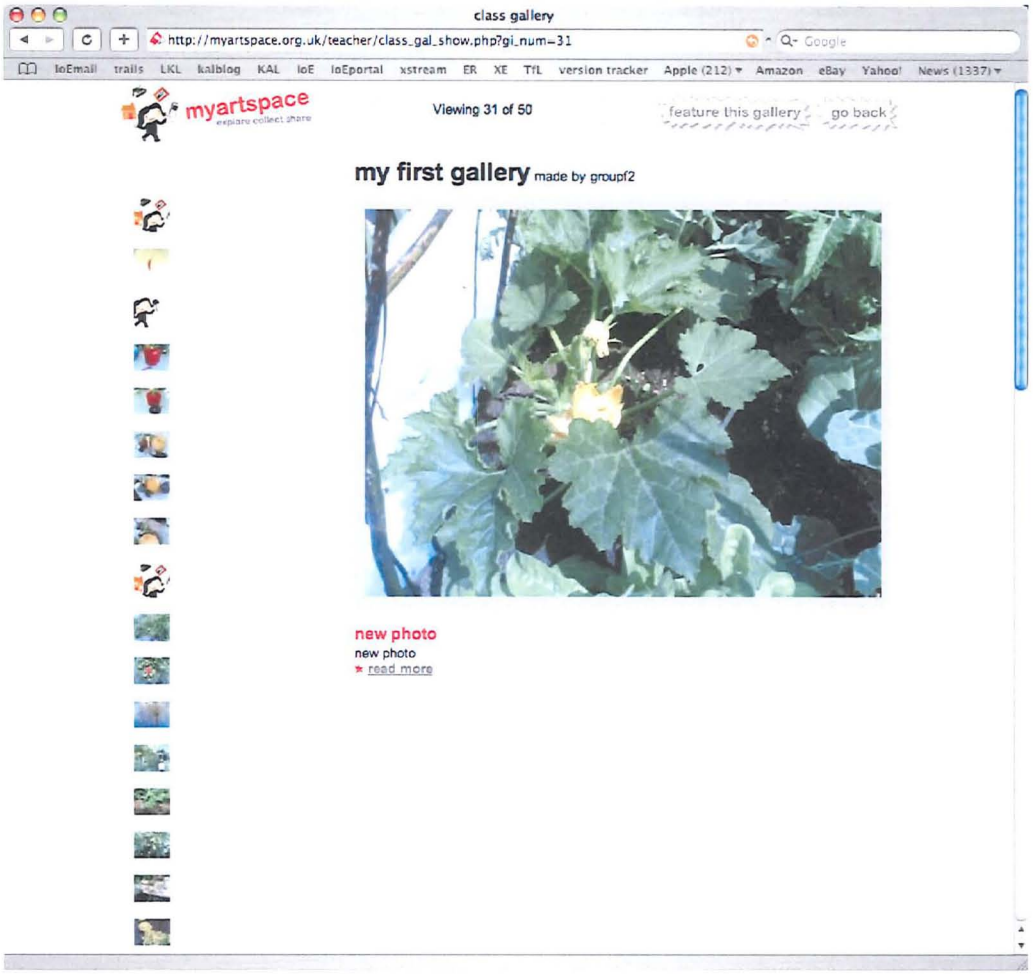


Figure 7.1 My Art Space web site showing a trail constructed by students in this study.

Phones running the My Art Space system capture discrete portions of data in the form of a single image, brief text message or audio clip. Each piece of media captured includes the facility for adding additional interpretation, either *in situ* using text entry on the phone, or afterwards on the web site. As discussed in Chapter 4, this thesis focuses only on students' in-museum activity.

For investigating technological mediation of trail construction, My Art Space introduced more potential complexity by using mobile phones instead of simple audio recorders. In the previous study, digital recorders became 'transparent,' to use the term of Kaptelinin and Nardi (2006) — they continued to prompt articulation and dialogue even when forgotten, and implicitly embodied the trails

concept. In this study, My Art Space introduced more opportunities for interaction and thus more opportunities for usability problems, on a much more complex device. This was seen to be potentially compensated, however, by the fact that mobile phones are much more widely used than portable digital recorders, and thus more familiar even to schoolchildren. The system also uses a simple software interface which constrains students to only the desired functionalities, with simple instructions and a minimum of device interaction to accomplish tasks. Students' use and understanding of the system is analysed in Section 7.3.6 in terms of how it supported trail construction activity.

Use of the My Art Space system was intended to inform all three research questions in this thesis. For Question 1 investigating the trails concept, it provided a built-in, trail-like structure which could be customised to curriculum aims by teachers; thus the technological embodiment of the concept was forseen to be more explicit. For Question 2 regarding mediation, while phones introduced more possible complexity, this was mitigated by the familiar nature of mobile phones and the proprietary My Art Space software which constrained users to designated functions; thus, its support for trail construction in terms of internalisation and externalisation was investigated. For Question 3 regarding the conceptual model, My Art Space was thought to be more suited to analysis in terms of context and activity, since the system is built around explicit goals while also using a trail-like structure, and was explicitly designed for student learning in museums.

7.1.4 Data collection and analysis methods

This study involved four school visits which were situated in the 'Plant Science Gardens' project, led by Dr Sue Johnson of the Institute of Education. She and I shared observations and data, but had different aims and approaches to the research, undertaking interpretation and analysis of the data separately (see Johnson, 2007). My role, therefore, was to integrate trail construction into students' existing activities in the Plant Science Gardens project, utilising the My Art Space system for trail construction, in order to investigate trails in school visits to a botanic garden.

Each class visit was directly observed, and recorded with audio, video and still images. According to Robson (2002), observation has the advantage of affording direct access to behaviours, unmediated by researchers' questioning and intervention, and is readily combined with other methods. His characterisation of 'descriptive observation,' in terms of the space, actors, activities, time, goals and

emotions (Robson, 2002:320) matches broadly with the Activity Checklist of Kaptelinin and Nardi (2006), which was utilised in the previous chapter, and which informs my TrACE conceptual model; Robson, however, does not separate context into personal, social and physical aspects.

Hammersley and Atkinson (1983), though, suggest that the researcher take account of variations in context, defining context not only as physical but social: for example, in their work in schools, they did not distinguish between the classroom and staffroom, since 'staffroom behaviour' could occur anywhere (Hammersley and Atkinson, 1983:51). They locate what could be regarded as the 'personal context' in ethnographic accounts. Therefore, the primary data collection method undertaken in this study was informal, unstructured observation, in order to collect qualitative data, allowing flexibility with regard to recording methods, and allowing for new hypothesis generation or unexpected events. This followed the ethnographic methods suggested by Hammersley and Atkinson, in which the researcher is neither 'fly on the wall' nor full participant, rather an active participant in the research process, playing an important part in shaping the context(s) of the activity (Ibid., 18). As such, my account is not claimed to be free of bias; instead, in my analysis I have looked for patterns based on my conceptual model, and constructed a narrative from that, in order to support or revise the theoretical generalisations arising from the model. These ethnographic methods conform to the methodological grounding of activity theory, detailed in Chapter 4 (see Kaptelinin and Nardi, 1997).

I did not attempt to record every aspect of each school visit, since a selective approach yields better quality data according to Hammersley and Atkinson (1983:48). My field notes were primarily in the form of audio and video, which the authors suggest can be more detailed and accurate than written notes alone (Ibid., 157). The recording was done by me, with video and audio recorders, in a fairly unobtrusive way — for example, standing some distance away from students as they undertook activities in the garden. I also used a digital audio recorder (iPod) which I placed into my pocket when interacting with informants, so as to make it as unobtrusive as possible. According to Hammersley and Atkinson (1983:162), when small portable recorders are used, informants tend to forget about the recording process, as against a researcher constantly taking notes. All participants were informed at the beginning of the day that they were being recorded, and were generally aware of the recording instruments.

The *in situ* recordings and observations were supplemented with follow-up interviews with teachers and students, which were also recorded with video and audio. The four teachers who led each school group were interviewed within days of each visit, and a sample of children was interviewed at each school six months after the visit.

The My Art Space system acted as an online repository for students' trails, containing text messages, images and audio clips, in the order that they were captured. This provided quantitative as well as qualitative data in terms of the number and type of photo, text and audio clips uploaded, which were tabulated in spreadsheets (one per student group). The audio was transcribed, and images broadly categorised for quick identification as those which contained people, plants, or both. Clips deemed unusable or extraneous were identified. The spreadsheets are in Appendix 6.

The trails and recordings were then analysed using Version 2 of the TrACE model, as iterated after the previous study. Specifically, the goals and object hierarchy of the activity are detailed in Section 7.3.1, and the general structure and development of the activity described in Section 7.3.2. Then the data, including audio and video transcripts, questionnaire responses, and the trail data collected by students, is analysed according to the categories delineated by the model: Personal and social contexts of subjects and artefacts (Sections 7.3.3 and 7.3.4); physical context of artefacts (7.3.5); and technological mediation of trail construction (7.3.6). Conceptual or theoretical issues emerging from the collected data are identified in the analysis; this process aligns roughly with 'grounded theory,' as described by Glaser and Strauss (1967).

In summary, the combination of students' constructed trails, as well as the observations and recordings, enabled reconstructing each group's evidence collection and trail construction activity in relation to the stated goals, which were then used to generate explanations and hypotheses in relation to the conceptual model; the model is iterated further throughout the data analysis, as in the previous study.

7.2 Description of the data collected

Across all four class visits, students captured more than 700 individual media clips using the phones, each consisting of one photo, audio clip or text message; each school's collective uploads ranged from 90 to 279 in number. Each student group collected an average of 32.9 uploads, with the lowest number being 7 and the highest 52. Half of the uploaded objects were photos, and most of those were of plants; of the remaining uploads, 17 percent were audio clips, 4 percent text, the rest not relevant or usable. The uploads are tabulated in Appendix 7. All the student trails appear in entirety in Appendix 8.

I recorded 1 hour, 4 minutes of video and 8 hours, 41 minutes of audio, all of which was transcribed by me, and in the case of video, described. Transcripts appear in Appendix 9. The recordings and students' constructed trails are analysed using the TrACE model in the next section.

7.3 Analysis of the data using the TrACE model

In utilising the TrACE model for analysis I begin by describing the goals and structure of the activity, detailing how the goals were framed and how they were realised in individual actions and operations. I then discuss the activity as it developed at a general level, and focus on specific aspects including internal/external components, performing tasks, conflicts and resolutions. Next, I focus on the different spheres of context from the conceptual model, beginning with participants' and artefacts' personal and social contexts, followed by artefacts' physical contexts. Finally, I discuss the tools used and how they mediated the activity.

In developing the model from the two analytical tools used in the previous study, individual indicators were identified for each aspect of the model, which are shown in the boxes in Figure 7.2; these are discussed in each section. The resulting analysis informs a further iteration of the model.

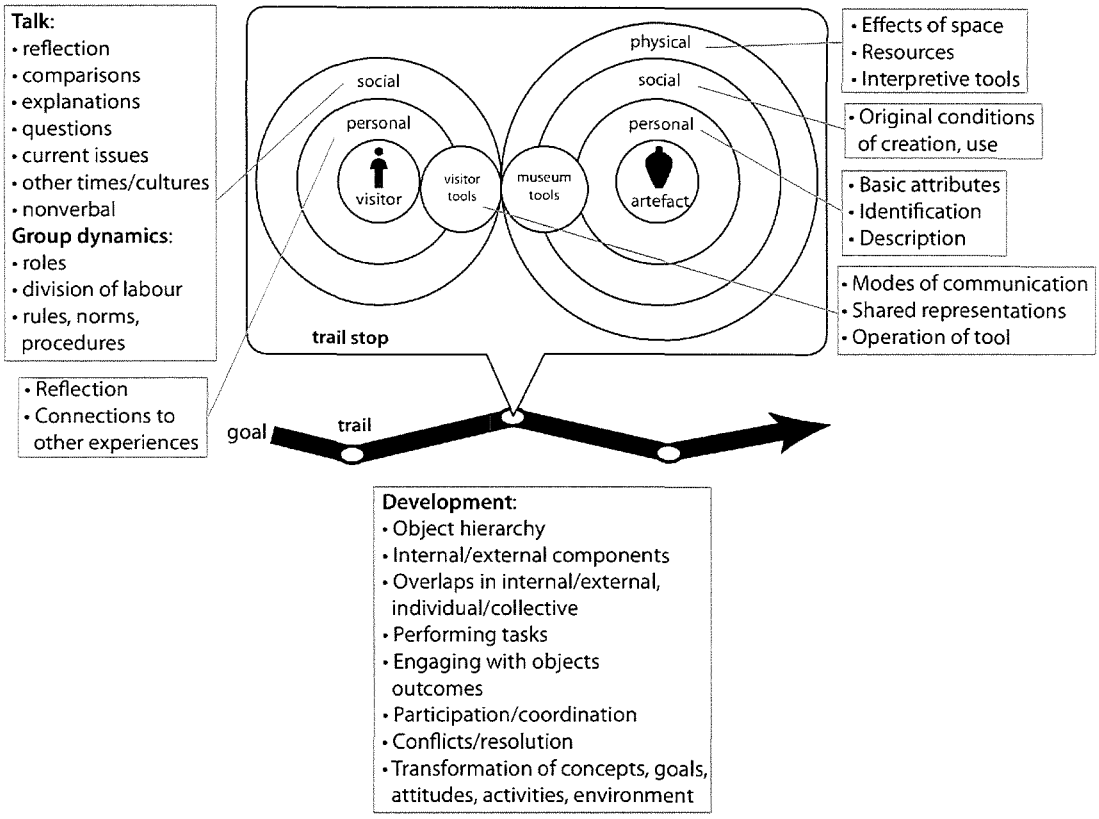


Figure 7.2 Version 2 of TrACE model as iterated in the previous chapter, showing indicators for each part of the model.

7.3.1 Goals of the activity and object hierarchy

The analysis begins with the goals of the activity, which is shown in Figure 7.2 as driving trail construction. Each primary school class undertook a module called 'Scientists sort plants into families,' developed as part of the Plant Science Gardens project, and designed by Dr Sue Johnson with Kew educators. The stated goals of this module were to promote critical thinking skills such as argumentation and discussion, and to encourage students to think like real scientists. The sorting activity engaged students in naming plant parts, and investigating the differences between fruits and vegetables, and particular plant families, through discussions, sorting cut vegetables, then finding plants belonging to a particular family in the garden's 'Order Beds,' collecting evidence for their

selections. Specific plant families studied were *Solanaceae* (tomatoes, potatoes), *Curcubitaceae* (squashes, pumpkins), mint, carrot and onion families.

The module was divided into three discrete activities. Each class was separated into groups of approximately five students each. In the first (indoor) activity, each group was assigned a plant family, and sorted a mixture of vegetables, putting plants they determined to be from the assigned family into a labeled box. This was intended to familiarise students with plant parts and morphological characteristics. The vegetables were bought from a shop, and students were allowed to cut them open in this hands-on activity, with no writing involved.

The second activity was to compare the vegetables in their box with those in the garden's outdoor Order Beds, which contain taxonomic groupings of plants; the Order Beds at Kew have been used for more than 150 years to teach students of botany and horticulture to recognise plants. In this activity, students had to decide whether their initial sorting was appropriate, looking for common taxonomic features (structural similarities). The module guidelines specified that students were to write in notebooks, three observations per student pair. Students were given a clipboard and worksheet for this purpose (Checklist for Observing Plants, Appendix 10; further information on the Plant Science Gardens project is at www.plantscafe.net).

In the final activity, each student group was secretly assigned one plant which it then investigated, and was instructed to 'create a poem, drama, mime or role play to describe their plant without mentioning its name,' according to the module guidelines. Each group then performed its poem or drama for the rest of the class to guess the plant. However, this activity was not used in this study.

Introduction of the technology

For this study, the topic of food plants was used to engage students in the additional activity of trail construction, which was intended to further support the goals outlined above. Each student group was loaned one mobile phone running the My Art Space software, for the stated purpose of trail construction. It was decided not to give each student a phone in order to stimulate dialogue and co-construction of knowledge, following on from the study described in the previous chapter in which dialogue in the form of questions, explanations and the sharing of experiences were observed in the collaborative trail of Rachel and Adam, who shared a single recording device. In this study, student

groups were instructed by Kew educators to use the phone as a scientific instrument to record observations, utilising the camera, audio and text facilities to construct their trails.

As described in Chapter 4, the 'object hierarchy' in activity theory refers to the chain of motives, actions and operations involved in an activity. Moving down the object hierarchy of activity theory, particular actions for capturing a photo, for example, involved selecting 'take a picture' in the My Art Space software on the phone, pressing a button to take the picture, then reviewing the picture on-screen and adding any additional descriptive information, before pressing 'Upload.' Similarly for audio recordings, when a recording was made, it was automatically played back for review, so that students could either upload or discard and record again. The My Art Space interface is shown in Figure 7.3.

Figure 7.3 My Art Space phone and interface showing main menu choices. The 'collect an object' function is not used in this study.

Moving up the object hierarchy, in contrast to the informal adult visits in the previous study, in formal school visits to museums goals are clearly defined around curriculum aims, with specific products to be assessed. The motives behind these goals are thus those common to formal education: for students, such activities are generally compulsory and thus motivation is therefore extrinsic; similarly, teachers must follow curriculum aims as interpreted by their local councils and head teachers. Regarding museum visits however, as with informal adult visits there is a leisure aspect, and both teachers and students view museum visits as a 'fun day out' for students that offers a break from every day at school (GEM, 2006). The danger of this view is pointed out by Rudman, et al (2008): 'At worst, the teachers do not plan visits in advance, the children rush around the museum filling out worksheets, and their only lasting memory is of a fun but disorganised day away from school.'

However, the plant sorting module utilised in this study was designed to counter this approach, and Kew educators' motives were, broadly, to focus students' activity on the topic. Simultaneously, both the teachers and the Kew educators thought that introducing mobile phone technology would engage students and 'make learning fun,' as one teacher said (Teacher interview, 22 June 2006); the Kew educators however were concerned that the technology would distract from students' encounters with the authentic artefacts (plants) — a common fear among museums, as discussed in Chapter 2.

For the developer of the My Art Space system, there was a commercial motive, since the software was designed to be sold to venues such as Kew Gardens. Thus the company was enthusiastic about trialling the system at Kew, and this ultimately met with some success, as the system was subsequently utilised by Kew afterward for other projects. At the same time, the developer regarded this study as a test for the system aimed at gathering feedback for further development. In this, too, it was successful; one result was that the system was later renamed 'OOKL' (anagram of 'look') in order to broaden its appeal beyond only art museums.

7.3.2 Development of the activity

This section describes how the goal of trail construction was interpreted by students as the activity developed over the course of the day. This activity is depicted in the TrACE model as shown in Figure 7.4, as an arrow stretching from the goal to vistiors' encounters with individual museum artefacts (plants in this case). The analysis includes looking for overlaps in internal/external and individual/collective components of activity; how students performed tasks and engaged with artefacts; the products they produced; how they participated and coordinated; any conflicts which arose and how or whether these were resolved; and how goals, concepts, attitudes, activities and the environment changed over time.

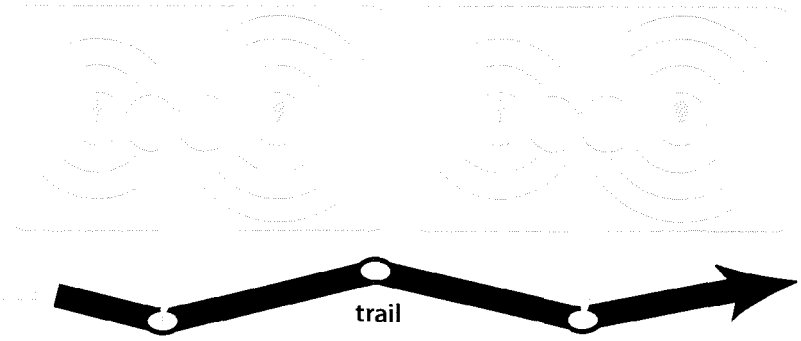


Figure 7.4 TrACE model highlighting the development of the activity of trail construction, indicated by the black arrow, as visitors encounter artefacts.

A narrative account following one group's trail construction activity will illustrate one way in which the goals were interpreted. In the morning sorting session, the My Art Space system was introduced as follows by Kew educator E1:

> I want you to record as you go along with your handheld, um, phone, what you — why you think it's like that, why you've chosen to do it. Take some pictures of what you've chosen as you go along as well. (Recording 20060605 104337, 3:35)

Following this instruction, one group (all girls) was assigned the courgette family, and used the phone to record an audio clip containing evidence:

> Student 1: Why do you think that is a courgette?
> Student 2: I think it is a courgette because it is long and green.
> Adult: OK.
> (Trail f1, stop 2)

The presence of the adult helper in the audio clip shows that the students' activity in this case was guided to some extent; adult support is detailed further in Section 7.3.4. The group then took pictures of vegetables they thought belonged in the family, as shown in Figure 7.5.

Figure 7.5 Comparison of marrow and courgette, photo taken by students for their trail. (Trail f1, stop 5)

These photos were accompanied by a text entry containing a hypothesis:

> The squash and marrow both fit in with the courgette. (Trail f1, stop 8)

Outside in the Order Beds, the group photographed a courgette flower, followed with several audio clips. The first was tentative:

> Student 1: Why does it have a flower on it?
> Student 2: I don't know.
> (Trail f1, stop 11)

Next they shifted their strategy to description:

> Student 1: We're gonna describe the courgette plant. It has a yellow flower. It's got spiky leaves round the edges which are green
> Student 2: and big
> Student 3: and the stems [recording cuts off]
> (Trail f1, stop 12)

Next they made a prediction:

> Student 1: How many courgettes do you think will grow on this plant?

Student 2: About seven, because there are seven buds on the stems.
(Trail f1, stop 13)

The group finished by recording another audio clip summarising their evidence:

Student 1: These are the similarities that we've found of the courgette and the cucumber family.
Student 2: The leaves are rough
Student 3: Some of them had vines
Student 4: And they usually have heart shaped leaves
Adult: There. We'll leave it at that for now.
(Trail f1, stop 23)

I observed the group recording this clip, and the adult (mother of one of the students and a non-teacher and non-subject expert) was holding and operating the phone, guiding the group in its observations and ensuring that they all participated. A portion of this trail is depicted in Figure 7.6.

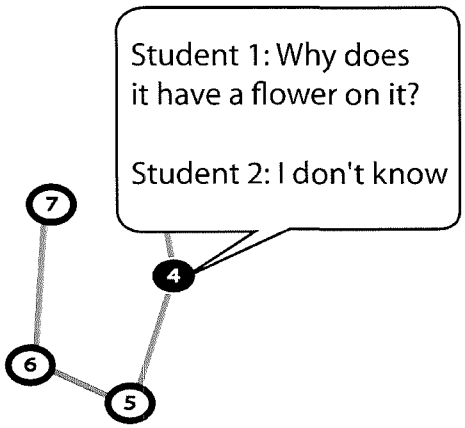


Figure 7.6 Portion of Trail f1, with one stop highlighted.

The portion of the trail described above shows how the group's understanding about the courgette family developed, from visual comparisons to descriptions to predictions. However, the group's completed trail masks the important roles of adults in guiding and ensuring participation, including the Kew educator who told how to use the phones, and the mother who assisted the group, which my observations have filled in, aided by longer audio and video recordings I made.

Most groups followed a similar sequence of inquiry, from observation to comparison to pattern recognition, and recorded their line of reasoning, creating trails frequently consisting of photos followed by audio clips as justification for their selections — in many cases with minimal adult help, and often no teacher help.

While the overall goal of this activity was to create a trail about a particular plant family, at each stop in the trail there was a sub-goal associated with a particular artefact (plant): to determine, through observation of morphological characteristics, whether that plant belonged to the courgette family, for example. Since the trail construction activity was set within the larger topic of scientific investigation, this meant connecting directly with the plants' personal contexts (defined as their individual characteristics, which were described in the above examples by the students). This frequently connected, in turn, to students' own personal contexts. Personal contexts are therefore explored further in the next section.

7.3.3 Personal contexts of students and artefacts

In the TrACE model, both visitors and museum artefacts are depicted as having personal contexts. In this section, the students' personal contexts are discussed first, followed by the plants'.

Students' personal contexts: Beyond artefact handling

In contrast to the museums studied in the previous chapter, science museums (including botanic gardens) utilise interaction, experimentation and artefact handling as ways for visitors to take ownership of their meaning making. In this study, all were in evidence, and in fact the activity went beyond mere artefact handling, when, for example in the classroom, students were allowed to cut open vegetables for close examination. For many students, this was not an activity they typically did at home, much less at school. But because they were studying food plants, there were strong connections to students' personal contexts, and they were able to use the senses of feel, smell and

taste (plant parts were referred to at lunchtime as well). In post-interviews, some students remembered how handling, cutting open and smelling the vegetables triggered memories. One, for example, said that 'before my mum would never let me....chop open a plant and see what was inside.' (Post-interview, 22.06.09)

Such personal connections were evident in students' trails, even though the trails were framed by educators as places to put empirical evidence. Personal connections were made, for example, when students went outside to the garden, where the very plants they had cut open could be found but in very different forms, growing in the ground. This connection was easier to grasp for some students than others, depending on their personal experience: for example some had been in the school gardening club, and one school was situated in a more rural setting with some students living on farms. One of the most remembered plants, overall, was the Mandrake root, which Kew educators related to a Harry Potter story — something most students were familiar with. Several students repeated this in their trails, as in the following audio recording:

> Student: Action. Here are some Mandrakes. They are in the tomato family. You will recognise them from *Harry Potter and the Philosopher's Stone*, when he pulls the plant out, and finds a little figure screaming. (Trail f7, stop 24)

The personal contexts of plants

In the previous study, I divided the contexts of museum artefacts in the TrACE model into personal, social and physical contexts. This study provided evidence that this conceptualisation could apply even to plants as artefacts. Defining the personal context as an artefact's individual history and attributes, it is clear from students' trails that they attended to individual plants, describing their attributes in detail, noting how they had developed in their places in the Order Beds (the plants' personal histories), and in some cases making predictions about how they would grow (their future). As a living, growing entity, a plant could thus be said to be more suited to having a personal context than an inanimate object.

As defined by Kaptelinin (2008), an artefact's 'activity context' encompasses its original conditions of creation and use, before it was collected by the museum; he refers specifically to artefacts which mediate the study of past cultures. In this thesis, a botanic garden fits my definition of a museum which collects, displays and interprets artefacts; similarly, plants fit the definition of artefacts which

have an original context of creation and use outside the museum. Fitting with my adaptation of Kaptelinin's model, visitors' personal contexts (as described above) are bridged with those of artefacts when visitors explore the personal attributes of the latter, and link them to their own personal experience; this is mediated by technology, for example when tools prompt and record visitors' observations and reflections. Thus, the role of the technology in this process of bridging contexts is discussed next. What Kaptelinin refers to as artefacts' broader cultural and historical context is, in my model, regarded as their social context; this is discussed in Section 7.3.4.

Technology and personalisation

In post-interviews, two of the four teachers said that students were able to 'take ownership of their learning' during the study, and linked this directly to use of the mobile phones, which were often used without adult supervision. One teacher commented that students appreciated 'being trusted' to use the phones; this was perceived to affect student motivation and self-esteem (Teachers post-interview 22 June 2006). Said another:

> It's a personal thing isn't it? It's *my* view. It's not a camera taking a picture, a piece of tech taking a picture, it's what I have to think and say about it, and therefore it's a very personalised thing. So I actually think that the vocal part is incredibly strong. (Ibid.)

As discussed in Chapter 4, Falk and Dierking (2000) view personalisation as a function of visitor learning in a museum, specifically involving a visitor constructing meanings by relating his or her own personal context to encounters with artefacts. By contrast, in the trails literature (e.g., Schoonenboom et al, 2007), in some mobile learning research (e.g., Kinshuk, 2009), as well as in research on museum-related technologies (e.g., Filippini-Fantoni, 2003), personalisation is defined as a technological adaptation to a visitor's personal choices or preferences.

The TrACE model in Figure 7.7, however, shows how in a museum, a mediating tool — in this case the mobile phone — facilitates personalisation even when it does not contain adaptive, intelligent software, by acting as a means of bridging the visitor's and the artefact's personal contexts through activity, here specifically by prompting the articulation of links between personal contexts in the process of trail construction. In the previous study, personalisation was defined as the transferrence of data from the museum-provided interpretation situated in the physical context to the visitor's personal context, in the process of constructing a personal interpretation, mediated by a visitor-carried tool. In

this study, however, students made direct links between artefacts' personal contexts and their own, without additional museum interpretative information; specifically, instead of being told which plants belonged to a particular family, they constructed these meanings themselves, sometimes linking the plants with their own personal experience.

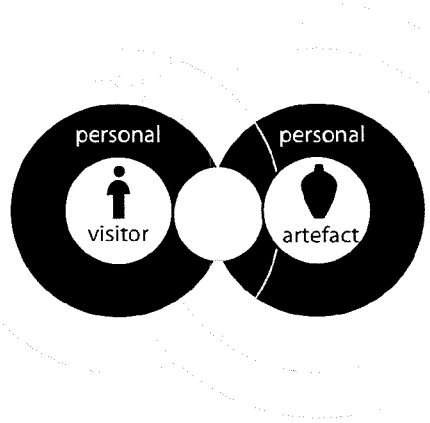


Figure 7.7 Personalisation results when a visitor's and an artefact's personal contexts are bridged, either directly or mediated by a tool.

An example of such bridging of contexts is illustrated in Figure 7.8. A plant is identified (identification being the most basic attribute of artefacts' personal context), and linked with the Harry Potter story familiar to the student. It also contains a link to the plant's 'social context' by referring to its taxonomic classification. This social contextualisation of plants is discussed in the next section, along with the students' social context of collaborative trail construction.

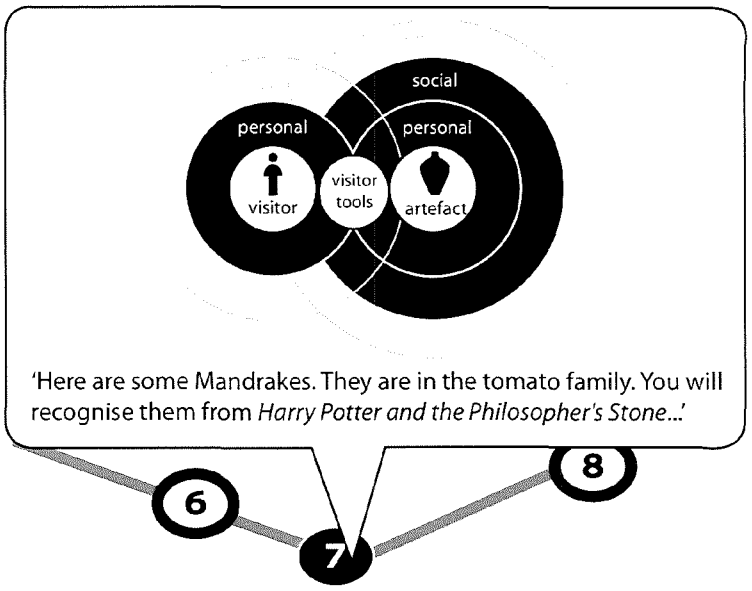


Figure 7.8 Portion of trail f7, with links between visitor's personal context (experience of *Harry Potter* story) and artefact's personal context (description) and social context (plant family) highlighted in black.

7.3.4 Social contexts of students and artefacts

As in the previous section, here the social context of students' investigation is first analysed, followed by a proposed 'social context' of plants. Visitors' social contexts, in the TrACE model, encompass two broad areas: collaboration, including the division of labour and particular roles; and dialogue, including reflection, comparisons, explanations, questions, links to current issues or other times/cultures, and nonverbal communication.

Division of labour in students' collaborative trail construction

In activity theory, the division of labour encompasses how tasks are divided horizontally among learners, as well as the vertical power relations. Both could be observed in this study. A horizontal

division among the students was imposed and enforced by the adults. For example, the phone was introduced by the developer on the first day as follows: 'During the day, you will each get a go at using the phone. So nobody owns the phone' (Recording 20060605 103131). There is ample video evidence of students sharing the phones, sometimes prompted by adults. Some students held the phone for long periods, and others showed no interest in it; but overall, sharing was common. Pairs and whole groups often gathered around the screen to look at photos taken, or to listen to recorded audio. Collecting photographic evidence (for example photographing cut vegetables) was done both individually (a student holding the phone in one hand and vegetable in the other) and collectively, as shown in Figure 7.9.

Figure 7.9 Student group photographing vegetables determined to be in the same family (From video 6 June 2006).

Adults often managed the division of labour during trail construction, as in the following exchange, recorded by me in the Order Beds:

> Adult: Okay, have a look there. Right? Do you think that's related to the pea plant?... Would you like to take a picture of that?
> Student: Hey whoever has the camera, take a picture now.
> Adult: Would somebody like to hold a hand next to it so — well you need to have it underneath here so that the seeds stand out. It's not that one, it's this one.... Okay. So that's where carrot seeds come from. You have to make it grow again.... (From video 6 June 2006)

This group of female students studying the carrot family was unanimously enthusiastic to use the phone, and the adult managed their use by suggesting five minute intervals for each student. Prompted by the adult, one student photographed another standing under a tall fennel plant:

> Adult 1: I'll tell you what you can do. How do you know it's two metres tall?
> Student 1: Who's a metre tall here?
> Student 2: I'm above a metre.
> Adult 1: Alright, get someone to stand underneath it.
> Student : Take a picture.
> Adult 1: This way. [Backs up and points.] Why don't you stand under there.
> Student 1 [takes photo] Look at this! [Runs to show others]
> (From video 6 June 2006).

They then gathered around the phone to view the photo (Figure 7.10).

Fig. 7.10 Students photographing fennel plant with human for scale, then reviewing together (From video 6 June 2006).

This group benefitted from having a knowledgeable adult helper; one of the teachers, in the post-interview, said she wished there had been one adult expert per group. Nonetheless, even non-expert adults generally managed sharing as well as observation and keeping students on-task; as another teacher said, 'Having that many adults there, they knew that they couldn't just sit back and not join in' (Teachers post-interview, 22 June 2006). At the same time, the teacher did not want too much adult intervention:

> With regards to their learning, we were happy to go along with the outcomes you had for them, but as a class teacher, I wanted them to work independently, and to reinforce their questioning skills for their science, which was exactly what they did. (Ibid.)

Adults, including Kew staff, helpers, researchers and developers, played important roles in supporting students in carrying out the activity; therefore visitors' social contexts include social support structures both formal (museum educators, teachers) and informal (adult helpers, others). This illustrates Luckin's (2008) conceptualisation of an 'ecology of resources' around a learner, which includes human resources; in the TrACE model this can be incorporated into the visitor's social context as 'social resources'; what Luckin terms 'institutional resources,' I have already characterised as part of museum-provided tools, in the physical context.

Independent student meaning making was bolstered by the assignment or adoption of specific roles. The technology played a large part in this, as discussed next.

The value of student roles in trail construction

The division of labour in trail construction was made explicit when particular roles were assigned to, or adopted by, students. One effective role was that of interviewer, using the audio recording function on the phone. In some cases adults controlled the recording process, holding and operating the phone, asking the questions, then holding out the phone for students to hear the resulting recording. But when students asked their own questions, they took ownership of the trail construction process, and this came closer to professional practice. As the developer explained to students on the first day:

> Whoever is holding the phone is like a journalist who's gonna record your evidence of what you're doing, and ask people to record answers to the questions you ask them. (Recording 20060605 103131, 7:45)

This technique was adopted by the all-female group discussed above, again prompted by the adult helper, as in the following interview observed by me and recorded on video:

> Student 1: Which family is the carrot in?'
> Student 2: What? I don't get you.
> Student 1 [into phone]: Sorry, I have to delete you.
> Adult 1: Think about it — you've got it written down.
> Student 1 [records again]: What family is carrot in?
> Student 2: [reading from clipboard] "*Um-bel-if-er-ae*"
> (From video 6 June 2006)

The student doing the interviewing appeared to relish her role, phrasing her questions carefully, checking facts on her clipboard, and brandishing the phone/recorder with a flourish as she conducted interviews, as shown in Figure 7.11. Later, she also recorded as the rest of the group was engaged in a discussion with a Kew educator.

Figure 7.11 One student interviewing another (from video 6 June 2006).

Going beyond simply asking questions and recording information for trails, a role promoted in the Plant Science Gardens module is that of scientist. There is ample evidence that students adopted scientific practices in constructing their trails, including observation, description, and asking questions — often of one another, as above, and not just adults. For example, one student in the post-interview recalled investigating a courgette plant: 'You were kind of experimenting, looking under leaves…looking at the soil, whether it was damp or dry' (Student post-interview 220609).

This exposes a blurring between the personal and social contexts, mediated by the tool. The phone supported student adoption of the role of scientist, since the phone was framed by Kew educators as a scientific instrument, and it effectively made possible the role of journalist by making interviewing much easier than with pencil and paper. Therefore, in student roles of interviewer/journalist and scientist, there is a clear relation between tools, the division of labour, and the object of activity.

Engeström (1987) depicts this relation in his 'extended activity system.' However, his model does not illuminate the importance of the tool (phone in this case) in mediating between a subject's social context (including the division of labour into roles) and personal context (including role adoption and the personalisation of role enactment during the activity). It also does not account for the physical context of activity, which is crucial to museum meaning making, as discussed in Chapter 2. Furthermore, Engeström's model accords equal weight to tools, rules and the division of labour; in the role-playing observed in this study, rules were fairly fluid — for example, while the role of scientist was formalised in the module guidelines, the role of journalist emerged from the suggestion of the developer and the capabilities of the technology. In contrast to Engeström extended activity system, my TrACE model, as shown in Figure 7.12, depicts a subject's personal context as surrounded — and therefore shaped — by the social context, with visitor-carried tools deliberately shown to bridge these two contexts; crucially in a museum setting, the activity is oriented specifically to encountering artefacts.

Figure 7.12 TrACE model highlighting the inter-relations between tools, personal and social contexts in subjects' goal-driven activity.

Students' spoken, and to a lesser degree written, language in this study played an important part, providing evidence, for example, that students adopted the role of scientist. The role of language is therefore explored next.

Students' use of language

Part of entering into a community, including a scientific community, is learning and using specialised language. There is ample evidence in the trails that students attempted using the plant morphology terms they learnt in the morning session, as well as language from museum interpretive texts, or from a printed checklist for observing plants created and distributed as part of the module. That technology played a key role in prompting students' use of language was recalled by one of the teachers in the post-interview:

> They loved using the mobile phones... and they said they really liked it because then they had to speak, they had to basically think about what they were gonna say, because they were really worried about what they were gonna say. So it meant that... using the technical language and what were they really saying, it made it clear in their heads what they actually knew, because they had to tell somebody else. (Teachers post-interview 22 June 2006)

As a result, students sometimes recorded Latin names and precise measurements, as in the following recordings from student trails:

> Student 1: What's the heaviest carrot and where did it come from?
> Student 2: The heaviest carrot is 8.5 kilograms and it comes from Alaska.
> Student 1: Good. That is the correct answer. Brilliant, love.
> (Trail f5)

> Student: Okay, we're working on the *Herculum candicans* now, and we figured out that the textures are different. It's spiky round the edges, and stems — ones are quite hairy, and the other ones a bit smooth.
> (Trail o)

> Student: This plant is *Laminium barginicum*... rub my fingers against them. Very strong smell, slightly of vinegar. Reminds me of very very strong mint. Lovely.
> (Trail t7)

Often, however, the scientific names were too difficult to pronounce (for example, *Umbelliferae* mentioned previously, read by a student from a clipboard), and students often resorted to familiar descriptive language; for example, 'There's purple fluff stuff' (SJ report 20060609). Hammersley and Atkinson (1983:153) refer to such familiar terminology as 'situated vocabularies' which informants use in the social construction of reality. One pair of boys in the study, for example, argued about making a recording for their trail, and this appears related to their failure to find the right descriptive language:

> Student 1: ... plant is very hairy
> Student 2: Even — no.
> Student 1: Even its stem is very hairy
> Student 2: Yeah. No. Its stem is lined with hairs, and even its flower is hairy. Even the buds of the flower are hairy.
> (Video 00137)

These two students shared an understanding of what a stem, flower and bud are, possibly from the morning 'parts of a plant' activity. They had learnt to look at visible features of these parts, 'hairiness' being one attribute. The second boy built the first boy's sentence into a more specific,

descriptive one. Their discussion was prompted by the phone, since they were negotiating the precise terminology and wording for a recording. They assumed the recording would be assessed by the teacher; therefore they wanted their evidence to be recorded in what they perceived to be the most accurate language. Interestingly, they wrote descriptions of the plants on their worksheets, but did not write a precise script for recording; having verbally agreed on wording and phrasing, each assumed the other had memorised the negotiated lines. This contrasts with what pairs of girls did in performing the same task — often meticulously scripting and rehearsing even before recording.

It is notable also that the My Art Space system limited recordings to 15 seconds in duration. Because the boys in the above exchange had made some recordings previously, they knew this; therefore when negotiating what to say, they attempted to make it concise as well as descriptive. They alternated between individual work (one student recording, the other writing), paired work (simultaneous observation, discussion), and interaction with the rest of the group.

Going beyond mere description, other students made predictions and generated explanations in their trails:

> Student: We've found some courgettes with flowers in. The courgette is still growing so it might turn into a big one. (SJ report 220609)

> Student 1: Why do you think the sticks are standing up above the [break in recording]
> Student 2: Because the leaves might grow bigger, and to keep the leaves together.
> (Trail f1, stop 21)

Based on the evidence as exemplified above, the use of language provided an important link to students' scientific understanding, and the technology provided a means to negotiate and articulate terminology, whether scientific or familiar. Students' use of language in this study related not only to the culture of science, but made links to other cultures as well, as discussed next.

Plants' social contexts: Links to human cultures

A teacher in the post-interview pointed out how students' use of language is related to cultural issues:

> A big part of how the national strategies are being adjusted now for September is taking account of this sort of speaking and listening.... We as a school have got two other problems, which is 94 percent of our children have got English as an additional language, so a lot of these children have as well. So they might speak English as well as, say, I might do. But there are whole levels of understanding, and the ability to manipulate language to be specific about what you mean. (Teacher post-interview 22 June 2006)

Another teacher related cultural issues to scientific inquiry:

> A big area for us is the children being very independent with their inquiry. For us, that's a bit of a cultural problem, because a lot of our children come from — culturally they're not expected at home to be asking specific questions, or necessarily engaging with kind of questions like, 'Oh look at that, and look underneath, and why do you think it looks like that...' (Ibid.)

As discussed in Chapter 2, links to other cultures are an important aspect of all museum meaning making, whether the culture of science or art, the original cultural contexts of artefacts, or contemporary cultures in other countries; encountering 'the other' remains one of the reasons people visit museums. Such links were present in the trails constructed in this study. Two students in the post-interview, for example, remembered arguing about a World Cup football match involving Trinidad, triggered by their encounter with a plant native to that country (as identified by a printed label). Another student in the post-interview had subsequently travelled to Australia, and encountered plants there which he remembered from Kew. These serve as examples of the 'social contexts' of plants — something that Kew emphasises in its educational offerings (for example its motto is 'Plants People Possibilities').

These examples show that, like inanimate museum artefacts, plants can serve to link visitors with other cultures separated by time or space. More broadly, the human relationship to plants was at the heart of students' trail construction activity in this study: When students interrogated individual plants' personal contexts in the form of their particular attributes, it was for the purpose of studying the plants' broader contexts: beyond merely taxonomic groupings of plants into families, it was their

use to humans as food. This is the social context of plants. Memories about a World Cup match or a trip to Australia were linked not to attributes of individual plants (their personal context) but by a class of plants — plants native to particular places. These social relations were evident in students' trails, and were thus also mediated by both the portable digital technology, as well as museum-provided resources such as descriptive labels. This relation is illustrated in Figure 7.13.

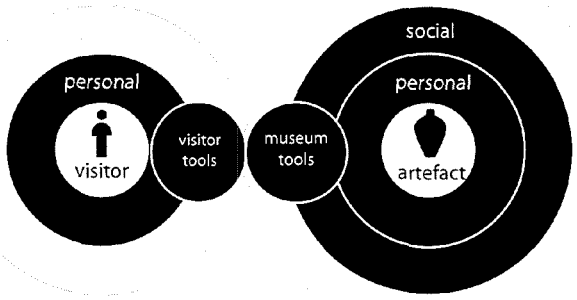


Figure 7.13 Visitors' personal experiences can link to artefacts' social contexts, mediated by visitor-carried and museum-provided tools.

To summarise, the social context of students' activity was a guided scientific investigation; the study of plants was framed in terms of their original (i.e., outside the museum) contexts of creation and use, specifically with regard to humans as food and as objects of scientific classification. Thus visitors' personal contexts include links to other cultures, and their social context is related to the cultural context in which the activity is situated (here the culture of science). Similarly, artefacts are situated not only with regard to their original context outside the museum, but also in the social context of the activity — again, here they were studied in the context of science, not on aesthetic or other grounds. This necessitates differentiating between the social *conditions* of the activity, including the presence of other visitors and stakeholders; and the socio-cultural *context* in which the activity takes place.

Thus, links to other cultures may exist in students themselves who may come from, visit, or hear about other places. Museum artefacts can trigger such links, which are most often expressed by students in the form of language, and in the trails this was mediated by the technology. Next, the physical contexts of the plants is discussed.

7.3.5 Role of the physical context in student trail construction

In the previous study, informants mentioned crowds and architectural features which affected their visit, but I hypothesised that over the long term, they would mostly remember the artworks. However, in the post-interviews for this study (conducted six months after the visit to Kew), some students specifically remembered things such as how unseasonably hot it was outside, and how planes flew low overhead. The low-flying planes directly affected making audio recordings for trail construction: recordings had to be done over when obscured by airplane noise, or else groups had to record in between the landing airplanes.

More broadly, sites such as Kew differ significantly from the museums studied previously in that Kew's exhibits are situated mostly outdoors. This also contrasted with students' school experience, as the following quotes from student post-interviews show:

> Student: Outside you can see what's happening and inside you can learn with books. So we can see [plants] in pictures and do stuff inside and we can see them for real outside. (SJ report 220609)

> Student: There are a lot of sciency things outside. (Ibid.)

However, while students perceived the outdoor spaces of Kew as more authentic for the construction of science-related trails, in the trails there is ample evidence captured in the Kew classroom to support students' hypotheses about food plants. It is reasonable to assume that students regarded the shop-bought vegetables used in the classroom as less authentic or 'sciency' than the same plants growing in the ground outside. It is also significant that the indoor space used was a classroom and not a museum.

In its outdoor spaces, Kew is free of some of the social conventions in art museums, for example, in which conversations are limited and/or hushed; here students could vocally argue, describe and negotiate, and the voice recording technology prompted articulation and discussion, as in the previous study. Also in contrast to some museums, at Kew the use of recording devices — including mobile phones — is not restricted either by rules or by thick walls blocking access to the network. While it fits my definition of a museum, Kew is perhaps closer to an interactive science centre than a museum: plants of interest to students were not in glass cases but generally near the edge of the Order Beds and thus easily inspected and touched; in some cases students had to lift up leaves in order to see fruits or

roots. So even the 'authentic artefacts' (plants) in the 'galleries' (gardens) could be touched and manipulated during trail construction, as could the 'handling artefacts' (cut vegetables) in the classroom. Nonetheless, unlike a science centre, Kew does not have interactive exhibits, rather collections of artefacts, arranged in social and physical contexts which are simultaneously 'authentic' and artificial, designed for both preservation and display, as in other collections-based museums.

Some students mentioned normally only being able to use laptops and the Internet indoors, and thus were surprised and delighted to use digital, networked technology in an outdoor setting. One student, for example, called it 'sort of like a miniature Internet connection' used to get and send information (SJ report 220609) Some teachers valued that the technology provided a means to collect data outdoors and link it directly to indoor teaching. Thus, outdoor locations were perceived as authentic science settings, but the technology could be carried between the outdoor and classroom settings, and used identically in both. This supports the placement of the physical context in the conceptual model, as shown in Figure 7.14, as a fixed location with regard to artefacts, which visitors move through, carrying portable tools.

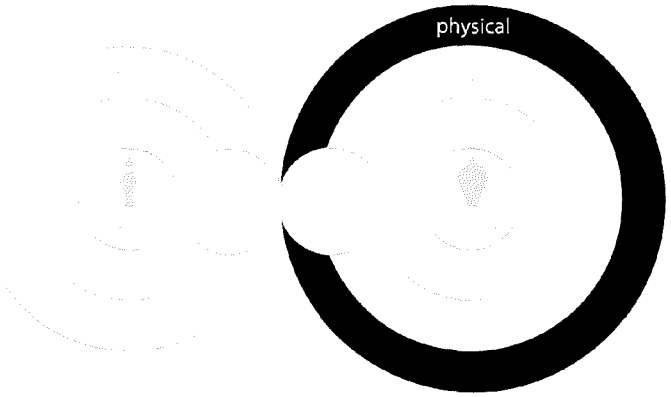


Figure 7.14. TrACE model showing physical context fixed to individual artefacts.

However, the cut vegetables used in the classroom session — analagous to 'handling artefacts' in other museums — conflict with this model, since they could be (and were in fact) easily moved from one location to another, and used in the presence of the 'authentic' plants in the gardens during trail construction there. In this activity, shop-bought vegetables could be considered 'authentic artefacts' as much as the plants in the gardens, since both were used equally to construct trails about particular plant families. The cut vegetables could be said to have their own personal contexts, including

attributes and history; but what linked them to the plants in the garden was a shared social context — their use to humans as food and as scientific objects of study, as described in the previous section.

When a student group carried a box of cut vegetables deemed part of the carrot family, for example, out to the Order Beds containing planted carrots, the students were effectively curating their own exhibition about the carrot family. An exhibition was defined in the previous study as the placement of artefacts by museum curators into a shared social context. But while a typical museum exhibition is situated in a single physical space, the students' curating activity stretched across the physical contexts of the garden and classroom. The one place where their exhibition came together was in the trail, which acted as a kind of curatorial armature or scaffolding. The means for constructing it was the phone containing the My Art Space software, which captured images, interpretations and evidence from multiple locations and placed them into a single place online. A trail can be defined, therefore, as a curated, linear exhibition — not in a physical but a virtual context. This is reflected in Figure 7.15, in which the positions of the social and physical contexts of artefacts have been inverted. Each artefact had its own physical context; placing them in a trail decoupled them from their physical context and re-situated them in a virtual one, within a shared social context.

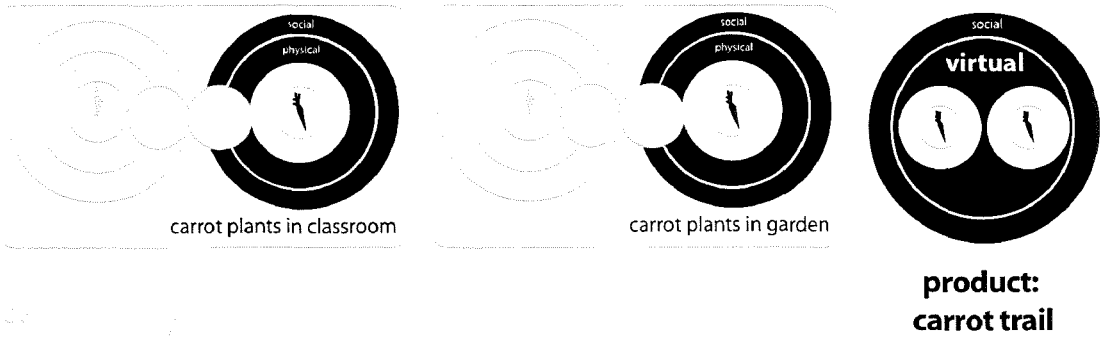


Figure 7.15 Example of trail construction activity as a recontextualisation of artefacts from a physical to a virtual context, while retaining (or creating) a shared social context.

This process of re-contextualisation matches that described by Kaptelinin (2008):

> When a museum artefact becomes an object of visitors' activities and visitors are attentively, cognitively and emotionally engaged with the artefact, the artefact can be re-contextualized in visitors' activities. By re-contextualization we mean the process of integrating museum objects, which had been originally developed for, and used in, certain activity contexts, into the context of visitors' own activities. Re-contextualization is the process through which visitors appropriate museum objects and their narratives. Designing for appropriation thus requires that both the context of use of the tool and the motivation for using the tool must be made highly relevant (Kaptelinin, 2008:10).

It should be noted that handling artefacts located away from their authentic counterparts (e.g., in a classroom) are a special case in museums, used primarily with school groups. Handling artefacts, when present at all, are sometimes located near their authentic counterparts. Thus in some cases, artefacts relevant to a particular trail (in other words, within a shared social context) will be in the same physical context (or gallery). Yet a socially-contextualised trail could include artefacts from different galleries, or other physical locations — even beyond the museum. Artefacts sharing a social context, therefore, need not reside in the same physical context; conversely, those sharing a physical context (e.g., in the same gallery) need not share the same social context. But if a trail is defined as a series of artefacts linked in a shared social context, regardless of location, then this justifies switching the positions of the social and physical contexts of artefacts in the conceptual model.

Trail construction activity thus acted as a means for students to navigate and take ownership of aspects of the physical setting, by recontextualising artefacts in a virtual space — a space made possible by the mediating technology. The role of the technology in mediating the students' trails is thus discussed in further detail in the next section.

7.3.6 Technological mediation of trail construction

This section focuses on tools in the TrACE model, including both visitor-carried and museum-provided tools, to analyse their role in mediating students' activity during trail construction.

Since the mobile phone technology was introduced to an existing activity (the Plant Science Gardens module), both of the Kew educators were unsure how to describe it and frame its use. They tended to

focus on the phones themselves and their portability. For example, on the first day, Kew educator E1 referred to 'special equipment' brought by the developer (Recording 20060605 103131). Later in the day, she said to students, 'You need to stay in your groups, because you'll need to be able to pass your, um, unit, your phone, from one person to another' (Recording 20060605 104337). The educators were conflicted by the phone's specialised role as a scientific instrument (the social context of its use in this activity) and the fact that it was just a standard mobile phone (its place in the broader cultural context).

Most of the students, however, seemed to adopt the phones as scientific tools for trail construction effortlessly, as shown in the student recordings discussed previously. This may have stemmed in part from their having used phones before, or at least having seen others using them; one student, for example, said in the post-interview that 'it was just like texting' (SJ report 20060609). For others, it was the first time using a mobile phone, and for them, the proprietary software made using the phone easier than would be the case with an off-the-shelf phone (though none of the latter were used in this study, so the comparison cannot be made definitively). There were still problems, both technical and conceptual, as one teacher pointed out in the post-interview:

> They enjoyed very much using them but I think they needed more detailed information about exactly how to use them. A few of them kept coming up to me during the day with the wrong buttons they had pressed, because it was so novel for them, it was something they hadn't used before.... Because a lot of them have their own mobile phone, it's a different set up pressing different buttons to do different jobs. (Teachers post-interview 22 June 2006)

Thus, the specialised software conflicted with the experiences of some students who had used mobile phones before. Overall however, all the teachers said in the post-interviews that the phones helped engage students with the plants and the trail construction activity, providing evidence to support the hypothesis at the heart of my Research Question 2 of this thesis: that portable digital technologies can help bridge visitors' contexts with the contexts of museum artefacts. For example, teachers said:

> Mobiles were really good to get them interested (Teachers post-interview 22 June 2006)
>
> Makes it relevant to them doesn't it? (Ibid.)
>
> The children felt that the 'best bit' was... using the mobile phones. (Ibid.)

As discussed, students' trail construction using the phones was often done independently of teachers, though mostly in the presence of an adult, and this supervision helped to keep students focused, according to the teachers. Students treated the phone with a measure of respect. For although it was just a mobile phone, it had the look and features of an advanced 'smart phone' (with, for example, two cameras and a large screen); this, combined with the proprietary software, made it indeed a specialised piece of equipment, as Kew educator E1 had called it, and students generally treated as such.

There is ample evidence that students externalised observations, descriptions, explanations, and dialogue; several examples were discussed previously. However, in contrast to the previous study, in this study this externalisation cannot definitively be linked to the trails concept and/or the device, for students were instructed to undertake these tasks as part of the their scientific work in the Plant Science Gardens module. What can be said with certainty is that the technology enabled more ways to record data than students would otherwise have access to, but there is no evidence that the software, or any other aspect of the device, facilitated internalisation of the trails concept. This is because throughout the trail construction process, students had to focus on several different tasks: locating plants in a given family, consulting their worksheets, conferring with other students, taking direction from adults, making observations, and recording data, either using the phone or on paper. Therefore, simply providing more ways to record data does not strenghten trail construction, without closer attention to the trail as a primary product and a concept for structuring the activity, which is clearly understood by all participants. While 'experience recording' as defined by Peterson and Levene (2003) results in a rudimentary linear trail of a visit, unless the visitor can internalise the trails concept and use it for self-regulation, the product may not be of much use to the visitor or anyone else. This does not mean that the trail construction tool should be used alone, only that it must be closely tied to trail construction as a primary goal. The relation of digital and paper-based tools is discussed next.

Comparison and inter-relation of digital and paper tools

The role of the phones stood in stark contrast to the worksheets and clipboards which most students carried and are commonly used both in class and on school trips. In this study, both phones and clipboards could be used for recording information (handwritten text and hand-drawn pictures in the case of clipboards), and both were observed to be used for this purpose. But only the phones were instructed to be used solely for trail construction. Each tool was framed differently: worksheets had

specific instructions on them (e.g., 'Is the stem ridged or smooth?') and were thus self-contained, while the phones had general instructions on them (e.g., 'Take a picture') and their use for trail construction had to be explained separately.

Additionally, because the phones were newer — both as a technology, and as a novelty — they attracted students' attention more so than worksheets on clipboards, though not to the exclusion of the plants: because the phones' functionality was restricted by the interface, and because the technology was closely tied to the concept of scientific investigation and the task of trail construction, the devices served to focus students on observation, interpretation and collecting evidence in the form of a trail, as demonstrated by the observations and teachers' comments described previously. However, the devices were limited to collecting data: once an image, audio clip or text message was saved, it was sent to the Web site and could no longer be accessed on the phone. This was not understood by educators or students, and many students captured data to use later in the day, only to find that they could not access it again. Thus, paper was the only medium students could use to record data for re-use while at the museum. This is a limitation of the My Art Space system.

Both the phones and worksheets could be considered 'visitor tools' in the TrACE model. One teacher decided to use the phones in place of worksheets, and said that students preferred the phones to worksheets, a finding also reported by Moussouri and Fakatseli (2009) who used the same system at another museum. But when phones and clipboards were used together by the other schools in this study, they were used creatively. For example, as described previously, several groups transferred information they had recorded on their worksheets to audio recordings using the phone. One group was also observed to use the clipboard in a more unconventional way: turning it around to provide a plain backdrop against which to photograph a carrot stem. Thus, students adapted the tools they had to the task at hand, echoing a finding by Vavoula (2005).

The role of voice recording in mediating trail construction

As discussed, some students meticulously scripted recordings for their trails on paper before recording them; in other cases the recordings were rehearsed and negotiated verbally. In both cases however, students paid close attention to the terminology they used, and discussed what to say before recording. Teachers consistently liked the voice recording feature on the phones because it made the recording of evidence and the use of language easier for students with literacy problems. According to one teacher:

> Anything that came into their heads straight away, they didn't have to write it down or anything.... I think in science sometimes, we spend a lot of time just sitting getting them to write stuff down, and for less able kids who are actually quite good at science, quite good at the vocabulary, it's really frustrating for them because they don't necessarily have the literacy skills to transfer over into science.... So they don't get frustrated and bunged up with saying, 'Oh we've got to write that down.' They get straight into the real science of it. Which I think holds a lot of children back. (Teachers post-interview 22 June 2006)

Use of the camera in trail construction

Personalisation was defined in Section 7.3.3 as the bridging of the personal contexts of visitors and artefacts through interpretation, mediated by tools. This could be seen in the images students captured, which were inevitably framed by students' perspectives, and focused on relevant attributes of plants, as oriented by the topic of the trail. The small size of the phone meant that a student could get it very close to a specific part of a plant to capture evidence, for example a flower bud or stem. However, the poor quality of the camera on the phone meant that it could not focus on close-up objects, resulting in many blurred photos in the trails.

Does simply taking a photograph constitute bridging the personal contexts of visitor and artefact? The personal context of a visitor was defined in Chapter 2 to include an individual's prior knowledge, interests and beliefs, as well as motivations and expectations, choice and control. These attributes were detectable in students' dialogue, and so too could they be observed in their actions, specifically the action of framing a photograph from one's own perspective. Additionally, the resulting photograph becomes a concrete product, as part of the trail, and could thus be later used for reflection or as an *aide de memoire*. In this sense, Hsi (2008) and Durbin (2003) consider visitors' photographs as a form of personalisation of the visit, which can be revisited on the Web. Thus, students' photos taken in this study can be considered as a form of personalised trail construction.

Conversely, collaborative photos were described in this study, for example a student group gathering to photograph one student standing under a plant to measure its height, or gathering to hold a selection of cut vegetables to photograph. However, photos in the completed trails often cannot be categorised as personalised or collaborative without knowledge of the social context in which they were taken, and/or their sequential context in the trail. Thus, while both individual and collaborative

photos can be considered to bridge visitor and artefact contexts, direct observation was valuable methodologically for distinguishing one type from the other.

A limitation of the My Art Space system was that an uploaded trail stop (or 'object' as the system terms it) could contain only a single photo, audio clip or text message, not a combination of these. Both students and teachers, while at Kew and in the post-interviews, wished they could upload a photo together with associated audio explanation or interpretation. However, students exploited the linear structure of the trail to get around this limitation, by for example taking a photo of a plant as evidence that it belonged in a given family, then recording a subsequent audio clip directly afterwards in order to explain their selection. This lent some thematic coherence to the trails. Thus, assigning a specific theme for a trail (e.g., the carrot family), along with specific instructions (e.g., capture evidence to support your hypotheses) overcame a limitation cited in the previous study — the lack of coherent links between trail stops. In this case, however, trail stops were constrained by the technology not to individual artefacts, but individual pieces of media. Thus in many of the trails, individual plants are referred to in multiple uploaded objects; the objects do not therefore correspond to individual trail 'stops'. While the system enabled the capture of multiple media types, it did not facilitate making links between them, whereas the linear nature of a thematic trail did.

Both digital and paper tools were used in relation with museum-provided tools — specifically, printed labels. Students were observed to write down information from printed labels — a common task associated with students using worksheets in museums. But students also took unprompted pictures of interpretative labels for use in their trails, as evident in Figure 7.16. This provides an illustration of 'multiple mediation' discussed in the previous chapter: students' learning about food plants is simultaneously mediated by the plants themselves; the museum interpretation selected by the students as useful to their trail; and the phone, which was in turn linked to the trail construction task, thereby framing the capture and use of the data. In 15 of the 21 instances in which a label was photographed by students, it was accompanied by a photo of the plant it identified.

Figure 7.16 Students photographing interpretive label for use in a trail.

This multiple mediation involving both visitor-carried and museum-provided tools is shown in Figure 7.17. Museum-provided tools are situated in the physical contexts of artefacts, and mediate subjects' encounters with artefacts' personal and social contexts, since tools such as printed labels give basic descriptive information (personal context) and interpretive information (social context).

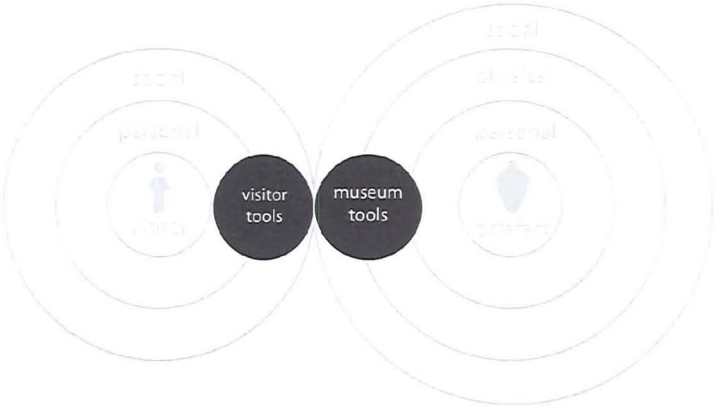


Figure 7.17 TrACE model showing visitor-provided tools and museum-provided tools (highlighted in black) mediating visitors' encounter with artefacts.

The Kew educators were initially skeptical about the technology, but were, in the end, won over. According to E1:

> I actually found that they used them, on the whole, quite sensibly, and did use them, and you know, enjoyed using them. I was very worried that it would detract from them actually physically looking at plants. But actually I found that that wasn't the case, that they did actually kind of use them — the technology — to kind of explore what they had to explore on the plant, but they had some fun technology to do it with. So I didn't mind that. (Teachers post-interview 22 June 2006)

In summary, the technology, with the trail construction task embodied in the device via orally-communicated instructions, framed student encounters with the plants. While it dictated which media students used in relation to the task (voice recording, image capture or text), it was flexible enough to accommodate creative expression and different aspects of data collection and interpretation. Although the My Art Space system was originally developed for art museums, it proved well-suited to an outdoor science context. Students adopted it more readily than adults, who had perhaps more preconceived notions about mobile phones, and the technology worked well in balance with the support provided by adults. It was preferred by students to traditional worksheets, but both tools were also used in complementary ways by students, for example for scripting recordings. Voice recording also functioned as an alternative for those who had problems with literacy or scientific terminology. And it worked well in conjunction with museum-provided interpretative tools.

However, the system had significant drawbacks. The captured data, once saved, could not be retrieved again on the device; this was overcome by using paper instead. And the system limited each trail stop to one mode of data capture, with no built-in means to link media; the linear nature of the trail was exploited by students to overcome this.

Next, all the findings are summarised in revisiting the research questions, before concluding with points to be addressed by the next study.

7.4 Revisiting the research questions

This study differed from the previous one in several respects: it utilised a different technology for trail construction, with a different visitor type, in a very different museum setting and topic area. Yet it remained focused on trail construction and technological mediation thereof, and sought to inform the research questions and conceptual model. In this section I revisit the research questions and the relevant points raised at the beginning of this chapter.

Research Question 1: (How) can visitor-constructed trails support meaning making in museums?

In the previous study, some value was seen in trails to support museum visits, but the trails constructed by the participants did not contain strong links between individual artefacts, nor did they have a topic or theme to lend coherence to the trail. Thus, this study was conducted within an existing school science activity, specifically on the topic of food plants. This not only provided a general framing for students' trails, it also provided specific instructions, such as to record observations and evidence; the technology dictated that these took the form of image, audio or text. The use of a topic in trail construction resulted in some clear and coherent links between individual artefacts, as examples presented in this chapter have shown. Additionally, within this structure students were creative in their use of the technology, for example interviewing each other, and capturing a wide range of photographic evidence. They overcame limitations in the technology — for example the inability to upload image and audio simultaneously — by utilising the linear trail structure and constructing trails consisting of, for example, an image containing evidence followed by an audio clip containing en explanation.

However, while most students understood the concept generally, trail construction was not clearly defined as a goal of the day's activity; rather, it was conflated with the goals of the Plant Science Gardens module, which were to undertake scientific observation and collect evidence. This was because the technology, and the task of trail construction, were introduced to an existing science module which had its own separate aims and objectives, and indeed its own tools and resources such as worksheets. Furthermore, neither the technology nor the trails concept was well understood by the two Kew educators, who in turn did not communicate it effectively to teachers and students. As a result, while the trails effectively linked individual artefacts in particular themes relating to plant taxonomy, they are generally lacking a coherent narrative structure to tie them together; narrative was identified in Chapter 3 as an important aspect of meaning making, with potential for trails. While the general theme of any particular trail can be discerned in most cases, and while in some cases students explicitly stated the theme of the trail in a text or audio clip, overall the trails are not coherent as standalone products.

This is related to technological limitations, as well as the design of the activity. Although My Art Space was custom-designed for school visits to museums, and utilises a trail-like structure, it relies on

students revisiting their uploaded data on the web site to shaping it into a coherent presentation. As discussed in Chapter 2, museum visitors rarely revisit data captured during a visit, although teachers are somewhat more likely to do so. Neither the teachers nor the students involved in this study did so, due to time and curriculum constraints which are common in both primary and secondary schools (Smith et al, 2009). While this thesis focuses on the in-museum experience only, in an explicitly goal-oriented activity such as in this study, attention must be paid to how (or whether) the products created during the visit are to be used afterward. In a school visit, this responsibility rests with teachers, for as shown in this chapter, students effectively used the technology for trail construction with assessment in mind, framing their evidence and phrasing their observations and descriptions carefully. Thus, one lesson from this study is that trail construction should be clearly identified to all stakeholders as a primary goal of the activity, with the outcome being a coherent, possibly narrative trail. Attention should be paid to how the resulting trail can or will be used, and any editing needed to make the trail coherent should be undertaken, if possible, during the museum visit.

The TrACE model depicts a single goal driving trail construction activity toward a single product. This study aimed to embed trail construction activity within an existing topic (food plants), but this conflicted with the goals of the pre-existing activity. Additionally, the TrACE model locates meaning-making from a museum visit in the bridging of a visitor's and an artefact's personal and social contexts. But since the pre-existing plant sorting activity was designed around collecting scientific evidence, students' personal connections to plants were not viewed as scientifically valid. Thus, while a guiding topic is effective in lending coherence to trails, trail construction should be the main goal-driven activity.

Research Question 2: How do portable digital technologies mediate and support trail construction?

Use of the My Art Space system in this study was intended to provide more explicit support for trails than the simple audio recorders used previously. But technological mediation did not always have the intended result. The system utilised proprietary software to embed a mobile phone into a school visit, with media capture capabilities to support a form of trail construction. However, although the products the system enables are *in effect* linear trails, the system instead terms them 'galleries' or 'presentations,' and this did not help to maintain a clear goal of trail construction. Also, the system was framed by teachers and Kew educators primarily as a scientific tool supporting the existing curriculum module, and not solely for trail construction.

Additionally, the capabilities of the system, and the way students used it, reflect a different notion of what constitutes a trail. Unlike in the previous study, which was based on the definition of a trail by Peterson and Levene (2003) as a trail of visited locations or artefacts, the My Art Space system conceptualises a trail as a linear series of media 'objects,' each consisting of image, audio clip or text. Its use of the term 'object' is close to that used in e-learning, as discussed in Chapter 3, as a self-contained digital 'learning object' not tied to a specific location but linked to a larger goal (in the case of My Art Space, a question or hypothesis set by a teacher). While Peterson and Levene envision visiting *existing* learning objects (whether analog, as in a museum; or digital, as in an e-learning system), in My Art Space each object is visitor-constructed. Thus, several individual 'objects' in a trail can be associated with a single museum artefact or location. A further lesson from this study, therefore, is that the definition of trails is tied directly to the technology used for trail construction, and in the goals and products both implicit and explicit in the technological system and the activity. This suggests a two-way relation between theory and practice: just as the use of a technological tool is influenced by how it is framed within the context of an activity (as audio recorders were implicitly linked to trail construction in the previous study), the activity of trail construction is influenced by the capabilities of a technology (as My Art Space conceptualises trails as a series of objects constructed by visitors).

In the previous study, visitors constructed a trail composed of their interpretations of visited artefacts (whether as discrete recordings or a single, continuous one), while in this study, each trail stop does not necessarily relate to a particular location or exhibit. Indeed, in no trails did students identify particular locations, because locations were not important either to the technological system or to students' trails, which were thematic, not navigational. My redefinition of trails in this study, as a social re-contextualisation of artefacts from a physical to a virtual context, can apply to trails which are either thematic or navigational. But further attention needs to be paid to the relation between trail stops and locations and/or artefacts.

The phenomenon of 'multiple mediation' was evident in this study when, for example, students used the phone's camera to capture information in a printed label. This form of multiple mediation can be added to that observed in the previous chapter, in which informants transferred printed information from a label to an audio recording — a method also evident in this study. In this study, the use of a particular topic in the trails was successful in that all the trails were constructed around particular plant families; artefacts were studied not for their own sake, but mediated the topic of the trail — a topic which equated with artefacts' shared social context, as defined by the goal of the activity.

While photographs were students' data capture medium of choice (based on the quantity of each medium used in the trails), teachers preferred audio because it enabled students who had problems with literacy or scientific terminology to nonetheless record their observations. The brevity of the audio recordings — dictated by technological constraints – also served to focus students on using descriptive and specialised language precisely in order to make concise recordings which they thought would be assessed.

In summary, a proprietary technological system may not be best suited for trail construction, even if its products are, in effect, trails; and particularly if it is not explicitly framed for the purpose of constructing trails in its interface, functionality, and use of terminology. Additionally, such a proprietary system is not readily available to a wide range of museum visitors, due to costs and technological requirements. More readily available technologies might more effectively support trail construction — if the activity is explicitly framed as such, and close attention is paid to the goals and outcomes. While a camera was useful for capturing aspects of the museum for use in the trail, audio continued to be the most valuable and interesting medium. Audio capture was used in conjunction with paper (the other visitor-carried tool in this study), while photos were used in conjunction with interpretive labels (a museum-provided tool).

Research Question 3: What is an appropriate model for the design and analysis of technology-mediated museum trails?

For reference, Version 2 of the TrACE model, as iterated after the previous study, is shown in Figure 7.18.

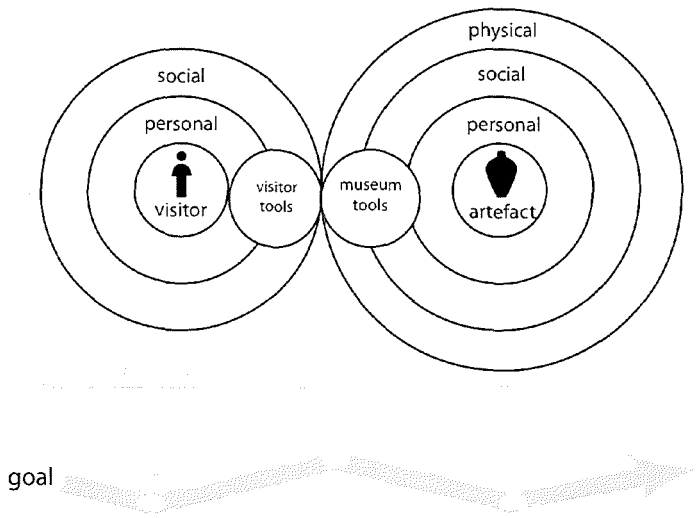


Figure 7.18 Version 2 of TrACE model, as iterated after the previous study.

In the previous study, trails were re-conceptualised as a goal-driven activity, and in this study were implemented in the context of a science investigation by school groups. Interestingly, the process of scientific inquiry is similar to strategies for studying artefacts in art museums, being centred on asking the right questions and learning how to look (Reynolds, 2007). In this thesis however, the constructionist element of a concrete output is instrumental. In this study specifically, while a concrete product previously existed in the form of students' filled-in worksheets, the mobile phone technology added the ability to use a variety of media to construct a themed trail.

Students' activity was shown to be mediated both by the tools they carried, and by tools fixed to artefacts' physical contexts, such as interpretive labels. One method utilised by students in trail construction involved the transfer of data from the fixed to the carried tool, by extension from the artefact's context to students' — for example by recording label text as an audio clip, or photographing a label for use in a trail. Meaning making, as defined by Pierroux, et al (2007) as the

bridging of visitor and artefact contexts, was observed in this study in the form of links between the personal and social contexts of students and plants, for example in links between individual plants' attributes and students' personal lives. The separation of artefact contexts into personal, social and physical was thus validated, with plants' social context for example being defined as their relation to humans as sources of food or objects of scientific investigation.

Trail construction was redefined as the re-contextualisation of individual artefacts in a shared social context, a process equivalent to the practice of curators; in this study trails were seen to involve a transfer of data from the physical context to a virtual context. In the TrACE model, this meant transposing the position of the social and physical contexts of artefacts. However, the placement of the personal and social contexts of visitors was validated, for example in considering how personal roles were shaped by social conditions of the activity, as well as by the capabilities of the technology. Conversely, personalisation of a trail was defined as the linkage of an artefact's personal context with a visitor's, as detected in language or in individual photographs for example. And the technology changed the way students experienced the physical context, for example by prompting them to look closely at plant attributes in order to photograph them, or to articulate descriptions carefully.

Based on the iteration of the TrACE model arising from the findings in this study, a logical sequence for analysis using the model is derived below, which replaces the indicators arranged in boxes in the previous version of the model (as shown in Figure 7.3 at the start of Section 7.3). The iterated model is shown in Figure 7.19, with each area of analysis detailed below it, in a linear list similar to the Activity Checklist used in the previous study.

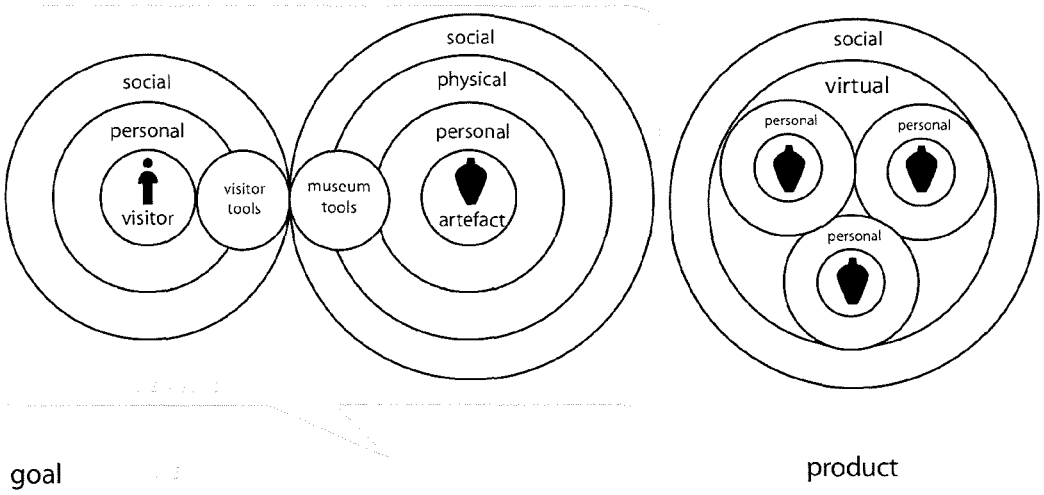


Figure 7.19 Version 3 of TrACE model, with indicators listed below in a linear list.

1. Goals
    - Goals and outcomes, e.g. 'Constructing a trail about food plants using audio, images, text.'
    - Sub-goals, aims and objectives, and relevant actions and operations
    - Means and ends, and general structure of the activity

2. Contexts
    - Activity develops through the interaction between visitor, artefact contexts
    - Personal context: consists of links between visitor's attitudes, experience, preferences, and artefacts' personal, social contexts; especially visitors' investigation of artefacts' personal attributes as a means of investigating the social context.
    - Social context: includes social conditions of visitors' activity including roles and division of labour; and visitors' language including description, reflection, explanations, comparisons, and questions.
    - Physical context: includes fixed and shifting environmental features and conditions, in relation to artefacts and other contexts.

3. Mediating tools

- Includes resources available in the physical context of artefacts.
- Includes visitor tools including modes of communication, relation to and links between museum tools.
- Use of tools and resources over the course of the activity are analysed in terms of mediation, conflicts and their resolution.

4. Product

- Products created by visitors in relation to goals, contexts, possible uses.

7.5 Methodological issues

Direct and recorded observation was effective in studying how participants navigated and negotiated trail construction, and operated the technology. Audio recording, in particular, captured valuable conversations and instructions by students and adults for analysis. My own role ranged from 'fly on the wall,' standing back recording at a distance, to actively participating — for example being enlisted to lead a group of students for part of the day during one of the class visits. Such direct participation helped me to understand the roles adults played in the activity.

I was selective in my observation and recording, and this was partly by necessity: with such large classes it was impossible to observe and record every student conversation and interaction. While the large number of participants yielded a variety of approaches to the activity, studying a smaller group in greater depth would enable a deeper narrative account; it would have been useful, for example, to follow a single student group throughout the entire day.

Interviews were useful, conducted in the field during the activity, as well as afterwards with teachers, students and museum staff. These prompted recall and reflection on the day, adding substance to what was, at the time, a sometimes hectic activity.

While the My Art Space system was useful for students constructing multimedia trails, it remains a proprietary system, designed solely for schools' use and not for casual museum visitors. There are other barriers such as the relative complexity of high-end mobile phones, as against simpler devices such as audio recorders; and network connection charges. While the addition of text and images added variety to the trail construction activity, because of the complexity of the technology, along

with the conflicts in its use of terminology (e.g., 'galleries' instead of 'trails'), and the lack of conceptual understanding of the system by educators in this study, the next study returns to the much simpler technology of digital audio recorders.

7.6 Conclusion

This study investigated primary students' (and supporting adults') interpretation of the trails concept, the technological mediation thereof, and the conceptual model for analysis, in a school visit to a botanic garden using a proprietary mobile phone-based technology. Various aspects were illuminated and the conceptual model refined. However, the following specific issues were identified with regard to the research questions:

Research Question 1: (How) can visitor-constructed trails support meaning making in museums?

- Trail construction should be clearly identified to all stakeholders as one of the goals of the activity, with the outcome being a coherent, possibly narrative, trail.
- Attention should be paid to how the resulting trail can or will be used. Can coherent trails be constructed which will have some use afterward?
- How best can a topic or theme for a trail be shaped into a coherent trail, and how could narrative best be employed?

Research Question 2: How do portable digital technologies mediate and support trail construction?

- The technology should be framed in the design of the activity as explicitly supporting the process of trail construction. Might a simpler technology be more suited to trail construction, instead of a proprietary solution built for a similar but different purpose?
- There remains an unresolved conflict between location and artefact: Are locations important in a trail, or only conceptual links?
- How can visitors best use captured museum-provided data in their trails?

Research question 3: What is an appropriate model for the design and analysis of technology-mediated museum trails?

- Further attention needs to be paid to how the imposition of a goal and product frame the trail construction activity.
- The model is centred on individual visitors and individual artefacts; could the relation between other visitors and other artefacts be clarified?
- How best could the social conditions of activity be differentiated from the social context of artefact-based meaning making?
- If the product of a trail is clarified and made useful in some way, how could its use by another visitor or visitors be represented?

In keeping with the aim of this thesis to investigate trails across diverse visitor and museum types, the next study involves a single group of three teenage visitors to a small history museum, who have the explicit goal of constructing a single trail to be followed by other visitors. They primarily use digital audio recorders, in relation to museum artefacts and spaces as well as other tools and resources. Thus the final study aggregates the findings so far, but returns to a simpler, more readily available technology, in a visit which is situated between the directed school trip explored in this chapter, and an informal, casual visit as explored in the previous study.

Chapter 8
Study of trail construction by secondary students at a history museum

In the previous study, four primary school classes were engaged in trail construction, resulting in a variety of approaches to the activity. After such a broad study, I identified a need to focus closely on a single, small group engaged in a narrowly-defined trail construction activity, in order to illuminate specific issues in detail. Therefore, and in keeping with the aim of this thesis to investigate trails across diverse visitor and museum types, the study described in this chapter is an in-depth study of a group of three teenage visitors to a small history museum, who had the explicit goal of constructing a trail to be followed by other visitors. They used portable digital audio recorders, as well as other tools and resources, which mediated their encounters with museum artefacts and spaces. This final study thus returns to a simpler, more readily available technology, in a visit which is situated between a formal school trip as in the previous chapter, and an informal visit as in the first study, while aggregating the findings so far.

Several issues were identified in the previous study with regard to the research questions, and these are addressed in this study as follows:

Research Question 1: (How) can visitor-constructed trails support meaning making in museums?

- In the previous study, trail construction was not clearly identified to all participants as a primary goal of the activity, because it was added to an existing activity, and the educators were uncertain how to frame the technology. In this study therefore, trail construction was

framed as a primary goal, with the product to be a coherent, narrative trail, produced by the students.

- Sufficient attention was not paid, in the previous study, to how the constructed trails would be used. Thus in this study, a coherent trail was to be constructed which would be used afterward by other museum visitors, who are demographically similar to the participants constructing the trail.
- In the first study, topics or themes were not evident in the constructed trails; in the second study, trails were situated within a broad scientific investigation and broadly themed around plant families. In this study the scope of the investigation was narrowed further, with the participants constructing a trail around a narrative related to central themes of the museum.

Research Question 2: How do portable digital technologies mediate and support trail construction?

- In the previous study, the technological system implicitly supported a kind of trail construction, but its role was ambiguous, having been framed as a general-purpose tool for data collection, and due to its proprietary design. Here, a simpler technology (portable audio recorders) was used explicitly for trail construction, as in the first study, but with a narrower scope and more clearly defined goals.
- In the previous study, trail stops were defined in the system as discrete portions of uploaded text, audio or images, which were not tied to specific museum artefacts or locations, resulting in a conception of trails closer to that used in e-learning systems (as described in Chapter 3), rather than Peterson and Levene's (2003) definition which is the basis for this thesis. In this study therefore, a trail was defined in direct relation to the technology used (as an 'audio trail'), and was tied explicitly to locations in the museum.
- How visitors can best capture and use museum-provided interpretation in their trails was an open question following the previous study, with participants for example photographing text panels for use later; however this use was never realised. Here, data capture on the device was necessarily restricted to audio recording, but the participants were also free to use other means; further attention was paid to the use of the captured data in the final trail.

Research question 3: What is an appropriate model for the design and analysis of technology-mediated museum trails?

- In this study, further attention is paid to how the imposition of a goal and product frame the trail construction activity, in order to inform the development of the TrACE conceptual model.
- The TrACE model is centred on an individual visitor's encounter with individual museum artefacts, while collaborative trails were constructed in the previous study. This study situates trail construction as a small-group activity as in the previous study, but only a single group was followed, in order to clarify the relation between co-located visitors and multiple artefacts and locations.
- In the previous study it was found that the model's depiction of the social context of visitors masks a distinction between the local social conditions of trail construction activity, and the broader social context of artefact-based meaning making within a scientific investigation. This study explores this distinction between social contexts in the domain of history, in order to validate it across multiple subject areas, and thus generalise the model.
- With the product and use of a trail clarified in this study, the representation of its use by other visitors in the model is also explored.

The research design is detailed in the next section, including a description of the setting, sample and methods used. Next, the data collected in the study are described. The data are then analysed using the latest iteration of the TrACE model, which is further developed throughout the analysis. Finally, the research questions are revisited and discussed.

8.1 Research design

8.1.1 Setting

This study took place at the Foundling Museum, a small history museum in London. The study was conducted over five weekdays during February, 2008. This was undertaken in conjunction with a programme called 'Young Consultants in the museum and archive sector,' funded by the Museums, Libraries and Archives Council (MLA) and intended to bring young people's voices into the museum. The programme was implemented in the form of work placement projects for small groups of young

people, with 80 young people at risk of social exclusion acting as consultants in 12 London museums, with the aim to co-create youth-oriented resources with museum staff. The audio trail described in this study was one of the resources created.

That this study took place over five days differentiates this study from the previous ones. The first study investigated trail construction in average adult museum visits of two hours or less; the second study was set in school visits of approximately 5 hours each. In each case the duration of the activity was appropriate to the visitor type, and as this study is situated in a half-term project involving young people, so too is the time scale appropriate. As before, no attempt is made to evaluate learning over a longer term, and the focus remains on in-museum activity. The long time scale meant that the students could become more familiar with the museum content than in an average visit of a few hours, as they focused solely and intensively on trail construction. Thus, this study affords an in-depth look at the trail construction process.

The Foundling Museum chronicles the story of the Foundling Hospital, a purpose-built home for abandoned children which stood near the same site from 1739 to 1954. It consists of original interior rooms and architectural features from the Hospital, artworks donated by patrons such as the artist William Hogarth, a gallery dedicated to the composer Georg Friedrich Handel (an early benefactor), and a contemporary gallery about the children who passed through the Hospital. Because the museum is small, all of the rooms were used in the construction of the trail in this study, with a separate education room used as a workspace by the participants.

As discussed in Chapter 5, this thesis aims to investigate the trails concept across different museum types, and thus this study is situated within the third and final broad category of museum: history. History is the most frequent subject area in which schools use museums, followed by art and design, and science, in that order (GEM, 2006; Hooper-Greenhill et al, 2006; Kofi-Tsekpo and Blay, 2006). As discussed in Chapter 2, history museums have a different epistemological stance than either art or science museums, relating knowledge to cultural identity. Trails are thus situated in this study as a means of exploring cultural identity through the relation of participants' contemporary lives to the historical culture(s) the museum represents; in the TrACE model this is depicted in the relation between visitors' and artefacts' personal and social contexts, as evident in the activity of trail construction, and as mediated by visitor-carried and museum-provided tools.

There are necessarily some overlaps between art, science and history, which were evident, for example, in the exploration of the mechanics of a moving sculpture in the first study, and in the

cultural dimensions of plants in the second study. In the Foundling Museum, artworks play an important role in cultural history, and the young people in this study used storytelling to translate the cultural history depicted in artworks into an audio narrative. The subjects involved in the study are described in the next section.

8.1.2 Sample

Three female students, all aged 16, took part in the study (hereafter identified as S1, S2, S3). Using a much smaller sample than the previous study enabled more depth of analysis, since the three participants could be easily observed and recorded throughout the entire trail construction process. They were recruited in the context of the Young Consultants project. Since the previous studies in this thesis focused on adults in informal visits, and primary students in formal school visits, this study aimed in between, at secondary students in something between an informal visit and a formal school visit. The students chose to take part, and their activity was structured to some extent — the scope being defined by the students themselves, in collaboration with museum staff. The particular activity agreed by the students and the Foundling Museum staff was the construction of an audio trail.

Foundling Museum staff involved included the Learning & Communities Manager who coordinated the project (hereafter identified as Museum Educator 1 or E1), and another museum educator who worked directly with the students, having previously worked with young people in arts-related projects at other museums (E2 hereafter). On the final day, a sound artist joined to help the students add sound effects to their trail. As in the previous study, all these adults were considered informants in this study, and their participation is analysed in terms of how they supported the students' trail construction activity. The mediating means used by the students are described in the next section.

8.1.3 Technology used in this study

In the first study, participants used portable digital audio recorders for constructing trails, but the resulting trails lacked coherence or structure, consisting of mostly disconnected interpretations of individual artefacts of interest. The second study aimed to improve the usefulness of trails by situating trail construction within topic-oriented school visits, and linking it to a mobile phone application purpose-built for something resembling trail construction. However, trail construction was not entirely successful in the second study either, partly because the goals of the activity were conflated with the broader aims of scientific investigation; and partly because the proprietary and

comparatively complex technology was not originally designed, or explicitly framed in the study, for trail construction as such. More specifically, the system was aimed at the capture of text, audio or image 'objects' which were not specifically tied to museum artefacts, and were arranged into 'galleries' and not 'trails' in the system. Mobile phones were framed by educators as tools for scientific data collection, yet the system was originally oriented toward the construction of art galleries, creating conflicted notions of tool mediation which were exposed by the conceptual model (see Section 7.3.6). By contrast, in the first study, audio recorders were perceived by participants as implicitly linked to trail construction, even while the trail construction activity was not well defined.

Therefore, in this study portable digital recorders were used, but here the activity was much more structured and oriented towards museum artefacts and locations, the links between them, and the product or outcome of the trail. In this study, audio recorders were used by the students to link museum artefacts in an overarching narrative structure, a structure inseparable from the medium — referred to by all the participants explicitly as an 'audio trail.'

This was to be the museum's first audio guide of any sort, and it aimed to provide audio devices to visitors at no cost. At my suggestion, the museum purchased three SanDisk Sansa m240 MP3 Players, which were capable of both recording and playback, and thus could be used by the students to construct the trail, as well as by visitors to follow the trail. The recorders were small, sturdy and inexpensive enough to be easily replaced if damaged or stolen. One of the recorders is shown in Figure 8.1.

Figure 8.1 SanDisk Sansa m240 MP3 Player, shown in the entry hall of the Foundling Museum.

The students used the audio recorders for rehearsing their narrative. Based on the research value of recordings of visitor conversations found in the previous studies, I also asked the students to make long, continuous recordings while they navigated the museum, discussed and constructed the trail, for my own analysis. They were also free to use other tools, based on the interactions between different tools observed in the previous study, and here they used paper and pen to write notes, make drawings and mind maps. These are all included in the analysis, and the paper-based tools appear in Appendix 11. The specific methods used in data collection and analysis are discussed next.

8.1.4 Data collection and analysis methods

The MLA 'Young Consultants' programme brought together the museum and the three students with the aim of undertaking a project to be defined by them collectively. I proposed to Museum Educator 1 the construction of an audio trail, which was agreed by all the participants. My role was therefore to help guide and facilitate the activity, with the agreement that I would use the collected data for analysis in this thesis in return. Thus, in comparison to the previous study, I had more influence in shaping the activity, and was able to apply lessons learnt in the previous studies.

As in the previous study, direct observation and audio recording of qualitative data was most important for capturing the activity as it developed. After consultation with the museum and participants, no video recordings were made. I recorded the participants using audio as they toured the museum, and they also used the device themselves to continuously record their trail construction activity, and to otherwise use as they wished.

In contrast with the previous studies, here I made greater use of focused interviews, interviewing the students and museum staff before and after trail construction. In focused interviews, according to Cohen and Manion (1994), respondents' subjective responses to a situation can be analysed in order to substantiate or reject hypotheses — in this case, interview questions were aimed at participants' understanding of the trail and the trails concept, their attitudes and experiences with the technology, and my hypotheses about trail construction, contexts and mediation, as formulated in the previous chapter. Interview transcripts appear in Appendix 12.

The audio recordings made by me and by the participants themselves served as data for analysis using the TrACE model. As in the previous studies, the audio was transcribed by me (transcripts appear in

Appendix 12). As mentioned, the participants in this study also used written notes, drawings and mind maps, and these were also included in the analysis (these are in Appendix 11).

The analysis proceeded using the indicators derived from Version 3 of the TrACE model at the end of the previous study. Specifically, the goals of the activity were first identified, along with sub-goals, as derived from the transcripts, project documentation, and discussions among the participants; these are described in Section 8.3.1. The general structure of the activity is then described in Section 8.3.2, along with the means and ends, drawing from the transcripts as well as my own observations. The development of the activity is then analysed by relating relevant parts of the transcripts and participants' written materials to the conceptual model, focusing on visitors' and artefacts' contexts and the links made between them. The role of language and dialogue is analysed next, followed by tool mediation, including the digital audio recorders as well as the written notes of the participants and museum-provided resources. Finally, the final product — the completed audio trail — is analysed in relation to the original goals of the activity. The data collected during the study are described in the next section.

8.2 Description of the data collected

As the scope of trail construction was deliberately narrowed, the completed audio trail comprises only 6 recordings, averaging 2 minutes each. But the trail construction process is documented with approximately 10 hours of audio recordings of discussions, encounters with the museum artefacts and galleries, and rehearsals. During the process, the students sketched the structure of their trail on big sheets of paper, and created two mind maps (one about the narrative they formulated, and one about sound effects they envisioned). They also wrote 13 A4-sized drafts of scripts; and 10 pages of notes made in the galleries and during discussions in the education room. Additionally, I recorded interviews of the students and museum staff of approximately one hour each. Again, transcripts appear in Appendix 12 and students' written materials in Appendix 11. The analysis of the data proceeds in the next section.

8.3 Analysis of the data using the TrACE model

After the previous study, a series of indicators for analysis was derived from the latest iteration of the TrACE model. The model is shown in Figure 8.2, followed by the indicators.

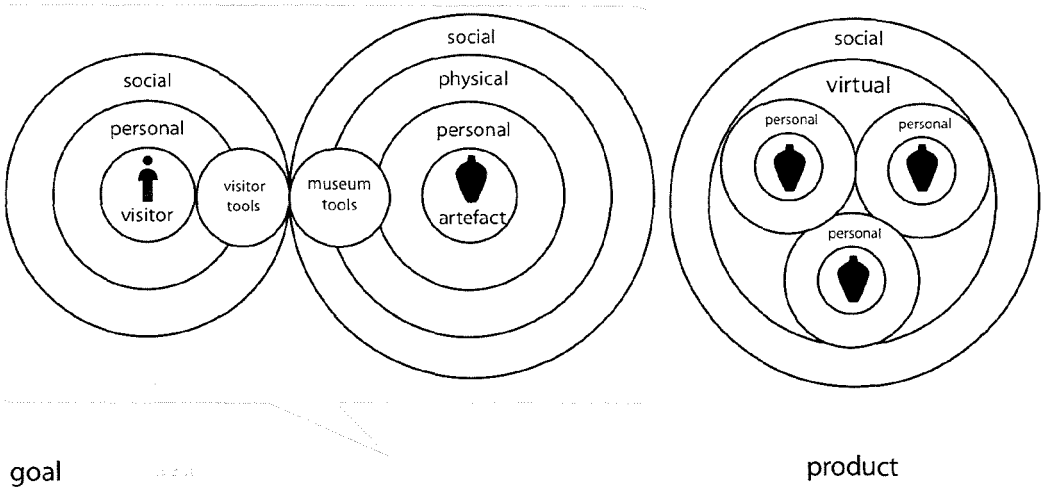


Figure 8.2 Version 3 of the TrACE model as iterated in the previous study, with indicators listed below in a linear list.

1. Goals
    - Goals and outcomes
    - Sub-goals, aims and objectives, and relevant actions and operations
    - Means and ends, and general structure of the activity

2. Contexts
    - Development of activity through the interaction between visitor, artefact contexts.
    - Personal context: Links between visitor's attitudes, experience, preferences, and artefacts' personal, social contexts; visitors' investigation of artefacts' personal attributes as a means of investigating the social context.
    - Social context: Social conditions of visitors' activity including roles and division of labour; description, reflection, explanations, comparisons, questions in visitors' language.

- Physical context: Fixed and shifting environmental features and conditions, in relation to artefacts and contexts.

3. Tools
    - Tools available in physical context of artefacts
    - Visitor tools including modes of communication, relation to and links between museum tools
    - Social resources and other stakeholders
    - Use of tools and resources over the course of the activity in terms of mediation, breakdowns and breakthroughs.

4. Product
    - Products created by visitors, analysed in relation to goals, contexts, intended and unintended uses.

The analysis below follows the order in the above list. First, the goals of the activity are identified, along with sub-goals, as derived from the transcripts, project documentation, and discussions among the participants. The general structure of the activity is then described in Section 8.3.2, along with the means and ends, drawing from the transcripts as well as my own observations. The development of the activity is then analysed by relating relevant parts of the transcripts and participants' written materials to the conceptual model, focusing on students' and artefacts' contexts. The role of language and dialogue is analysed next, followed by tool mediation, including the digital audio recorders as well as the written notes of the participants, and museum-provided resources. Finally, the completed trail is analysed in relation to the original goals. The analysis informs a further iteration of the TrACE model.

8.3.1 Goals of the activity and object hierarchy

In this study, the goals and outcomes of the activity were made explicit to all participants. The overall, agreed goal of the activity was the construction of an audio trail by the three students, in and for the museum. The product — the completed audio trail — is an implicit part of the stated and agreed goal; the broader aim of the project in the context of the Young Consultants programme was to create a resource for other young people. Some domain knowledge (e.g. about the museum and

history) and skills (e.g. operating the technology, storytelling) are implicit in the task, and are referred to throughout the analysis.

As described in Chapter 4, the 'object hierarchy' in activity theory refers to the chain of motives, actions and operations involved in an activity. Taking the above stated goal as a starting point, moving up the hierarchy it can be seen that since this took place during the students' half-term break and was not part of formal school activity, it can be inferred that the students had some intrinsic motivation to participate. This is revealed in conversations between the students and Museum Educator E2:

> E2: How come you wanted to join [the Young Consultants programme]?
> S1: Oh. Um, our friend told us about it. And she said, 'Just come and see what it's like' And then we came, and we got interested.
> S2: She told us about it first, but we didn't really care about what she said. And then we went.
> (Recording VORC002, 53:30)

The above transcript reveals that the students' peer group influenced their participation. It is unlikely that they were interested specifically in museums, as revealed by subsequent conversations with E2:

> S2: When I tell my friends I'm going to a museum they're like, 'Huh?'... Teenagers just wouldn't think of going to a museum for any reason, 'cause nowadays museums, they're for old people.
> S1: THIS museum I think is for old people, not the Science Museum, or the Natural History Museum. I don't mind going to that, or taking my little cousin to it.
> E2: Or even Tate Modern. Have you been to Tate Modern? I mean, most of the people there are young.
> S1: Yeah, but this museum's a bit —
> E2: This museum — true, most of the visitors are quite old. Apart from weekends when we have little children or something like that. But, this museum's history is all about children — that's the difference.
> (Recording VORC002, 1:24:16)

This extract supports research showing that young people do not feel they have their own place in museums socially (Fisher, 2007). In this case, once the students agreed to participate, their

participation was shaped by the goals of the Young Consultants programme. According to the MLA, the programme was intended to empower young people to contribute their views to museums, and conversely to act as advocates for museums to their peers, through consultations with museums, peer research, 'ambassador work,' and co-creation of new resources (Larsen, 2008:3). It was the co-creation of a new resource which drove the Foundling audio trail project, and the programme's goals were interpreted by the Foundling's Learning & Communities Manager (E1) as follows:

> I think if young people come to our museum it's quite boring — it can be quite boring if you don't know anything about it. So what we find with school groups, or any other groups that come in, is that if you do activities to sort of explain, you know, show things, they get it.... Which is why I wanted to do this audio trail, so that young people could come in and have that experience, even if there wasn't a member of staff here. (E1 post-interview)

This was negotiated with the students as follows, according to E1:

> They were happy to do the audio trail, yes. And I think it tied in, because they clearly wanted to do this drama element.... they worked out they wanted to do something drama-y. And I could see that you could tie the two in together. (Ibid.)

The other museum educator, who was to work directly with the students, was trained as an artist and viewed this as an arts-related project:

> I think the main purpose is to provide a platform for young people to express themselves and make their own artwork. And definitely bring them into the galleries as well. Because some people might feel very intimidated with art, either an old, historic artwork, or contemporary. (Recording REC19, 6:30)

Moving down the object hierarchy shifts the focus to sub-goals. The overall activity having been agreed by all the participants, my role was to guide and facilitate trail construction, and I suggested the following ideas to E1 in an email message, based on findings from the previous two studies in this thesis:

- Limit the scope/focus: 6 or 7 stops in the tour
- Have a strong narrative theme linking the stops (even if they are random access)
- Interviewing each other works well

- Have them treat it like a podcast or radio journalism: interview each other, do research, shape it into a story
- Role playing works well: in that case would have to be scripted
- It would be good to record each stop in the tour in front of the particular artwork: that way they can refer to particular features, but it also preserves 'room tone' which would enhance the feeling that they're standing next to the listener in the room.

(Email message to E1, 27 Jan 08)

The students and educators generally took up my suggestions, agreeing on a small number of stops, one in each room, each stop focusing on one or two artefacts. The students created characters derived from real historical figures they encountered in the museum, and set these characters in conversation within the audio trail. The trail stops were written and rehearsed by the students in the galleries.

I made the suggestions to E1 unaware that the students had already agreed on an element of drama; thus narrative was a significant element from the outset. As discussed in Chapter 3, there is substantial evidence of narrative as a tool for meaning making, and museums provide narratives which can complement or counter visitors' narratives. Some museums introduce elements of drama, including fictionalisation, through performances by actors, in films and other programming, and sometimes by visitors themselves — usually school or family groups. Hooper-Greenhill (2007:37) states that 'learning through experience is learning as "performance,"' and she distinguishes 'performance' as related to measurable targets in schools from 'performativity' in action and behaviour. Parry (2007:73) views the act of curating as a form of creative performance, and the activity undertaken by the students in this study can be regarded as an act of curation as well as performance; in the previous chapter a trail was redefined as a curated, linear exhibition in which artefacts are re-contextualised from a physical to a virtual context. Audio recording acted as a means to that end in this study. In related research on portable digital devices, Jokela, et al (2008) found audio to be particularly important for narrative construction.

As with many history museums, the Foundling Museum has a particularly strong narrative aspect, telling the story of the Foundling Hospital, which in turn contained many individual stories of children, their families, Hospital staff and benefactors. The process of constructing the narrative trail, including specific actions, discussions and decisions, is detailed in the next section.

8.3.2 General structure and development of the activity

In this section I describe the activity and how it developed at a general level, before focusing more closely on specific areas of context in the following sections.

The students originally wanted to perform a drama separately. E1 proposed merging the two ideas:

> So there's the idea that you just go round and explain what you see. But I thought another way you might be able to do it — I don't know — is, if you're creating these characters from your drama, those people could tell a story as they go round. So instead of you just saying, 'Here we are in front of a picture,' to say, 'This happened in this room, and I'm coming in here and this painting or that painting gave me this memory,' or something like that. (Initial group interview, Recording REC13)

This idea was reinforced during students' subsequent work with the educators, specifically when they went through the museum together, 'so they could get an idea of what it was all about,' according to E1. She continued:

> And in the courtroom we did this activity which I do quite often with students.... What they do is we have three petitions of mothers, and they present their petitions to the governors, and the governors get to decide which baby gets to come in. Obviously it was just [E2] and I were the governors that day. (E1 post interview)

This scene became a central element of the students' character and story development, and they negotiated the details together, as in the following conversation:

> S1: We need a main story. I think the main one should be a mother bringing a child in. That should be the main story. And then, from that, we should go on to like, what the child —
> S2: Into different rooms and stuff.
> S1: Yeah. So OK we've chosen that.
> (Recording VORC001, 0:20)

The characters decided upon were drawn from actual stories the students encountered in the galleries, again prompted by E1:

> Or say, in the social history gallery, there's a whole wall of names. So if you wanted to choose a child, we could find a name of a child, each child who came in, they had a number... and you could find out a little bit about what happened to them when they left. So maybe you want a good girl who became a nice servant, or someone who actually ended up in the workhouse. So, and then, anything more than that, you could, you'd have to make up. And you could even put two of those together, you could have a mother and her daughter. (Recording REC13)

From here, the characters and narrative were shaped through discussion and negotiation, as the students navigated the museum without the educators, and reflected later in the education room:

> S2: You know one of the letters I read this morning? We could choose a more — the one she [S3] read.
> S1: I think mine was great. Mine was great!
> S2: Do you remember anything from it?
> S3:Um, yeah. She just talked about how she felt about it.
> S2: We could improvise, make things up. Yeah? Just write what you remember, and make things up. So, you can just say what you think it was about.
> (Recording VORC001, 6:50)

There was still some debate as to whether the trail should be a dramatisation, but the educators pressed this point:

> S1: But I think it's kinda hard, if we wanna, like, put the drama into the audio trail, it's kind of hard to do that. If we just like, went around the museum, showed them like, what we was initially gonna do, like show them around what we like, and what's interesting and whatever, I think that'll be much easier than to —
> S2: — do a drama that's in the audio trail.
> E2: Well yeah. But you've got your drama and you've got your characters. If every one of you is gonna be a different character like you say — governor, mother, child — which, you can incorporate into the audio trail. I mean, in the audio trail you can be the same people, showing the visitors around. Because it's quite dry, if you just say on the audio guide, 'Uh

yeah, this is this, this is that,' it might make it a bit — it might bore someone. Whereas if you make it a bit more engaging, like, you're the governor, and you change your voice like this [deeper] and that, and you — like more personal I think.
(Recording VORC001, 27:42)

In the end, the dramatised audio trail was agreed upon. The following are excerpts from the completed trail; the complete transcripts are in Appendix 13.

Stop 1: 'Coram's Children' gallery

S1: My name is Mrs. Copperbottom and I am one important woman. I am the governess of the Foundling Hospital. I am from the high class, and in my opinion of London, hmm. Well London is a very dirty place.... If you walk to your right of the room you will see a picture of Gin Lane [horse sounds]. Hogarth's interpretation is exactly correct [pig sounds].... If you walk around the wall behind you, you will see what our hospital looked like [birds singing]. Don't you think it's a grand building?

Stop 2: Committee Room

S1: One busy day, I, Mrs. Copperbottom, was reading important documents, on precisely May the 13th, when I was disrupted by a woman with a baby, and a police guard.... What are you doing in here? You're supposed to be in the courtroom.
S2: Yes ma'am. My name's Margaret Lanier, and I need you to take my child.
[...]
S1: And where's your husband gone?
S2: He was drunk and abusive, and I was protecting my child, and my unborn child.
S1: So you killed your husband.... I'm sorry to say that we won't be able to accept your baby.
S2: Miss, please take my child! I don't understand -
S1: We will not be able to accept your baby. Can you take her away please!
[sound of door slamming]

Stop 3: Courtroom

S1: Next please! Um, can you shush that baby and take a seat.... And um, what brings you here?

S3: I'm Eliza Jefferson, and I work with Mistress and Master Smith, and I've been away with my child. And I'm soon to return to my master, and my mother is very unwell to take care of my child, and I need you to take care of my child for me.

[...]

S1: Okay. And why can't you look after your child?

S3: Um, I was forced into this pregnancy by Ben, and he —

S1: Who's Ben? Was you married to Ben?

S3: He promised to marry me before the birth of this child, but he's gone now, he ran away.

[...]

S1: Okay. Well hearing your story I've come to the conclusion that your child may be accepted into our Foundling Hospital....

Stop 4: Picture gallery.

[gentle orchestral music]

S3: Taking my little baby to the Foundling Hospital brought a lot of different emotions to me.... I was asked to leave a token to my baby for easy access to reclaim her. I left a black and white beaded bracelet in the token box. It was the only thing my grandma gave to me before she passed away.... Seeing a picture of Thomas Coram, looking kinda nice with his big red coat, reassured me that my baby was in good hands.

Stop 5: Anteroom

S2: I was one of the many foundlings in this hospital. Like all of the other children I do not remember my mother, and have nothing of hers. When I was 12 years old, I overheard the matron and the secretary talking about the beautiful token my mother had left me. It has never been given to me.

[sounds of dining room]

I remember on Sundays when we ate, wealthy visitors use to come around and watch us.... Thinking of these things made me very emotional, and in this strict hospital, it is hard to express yourself. Singing was part of me releasing my feelings. Every Sunday I used to sing in the church choir [sound of choir]. These are some of my best memories from the Foundling Hospital.

Stop 6: Handel gallery

[Handel music plays in background]

S2: Dear Georg Friedrich Handel,You are the best musician of our time. The other foundlings and I always look up to you and we wish we could sing over your music one day. You are a very important man to the hospital and I still do not know quite why, but your name is always mentioned at Sunday concerts.... I want to be a composer just like you one day, but I fear I will just be an ordinary servant. Please write back, Amy Bentley.

S1: My good friend Handel is an absolutely fabulous musician. He helped fund our hospital by making awesome concerts. He is an inspiration to a lot of our children. He was actually an orphan, and was in a similar situation to some of the foundlings at the hospital. He actually composed the Foundling Hospital's anthem. He is simply too great and will never be forgotten. Mrs. Copperbottom, Governess of the Foundling Hospital.

[music fades]

The trail is depicted in Figure 8.3.

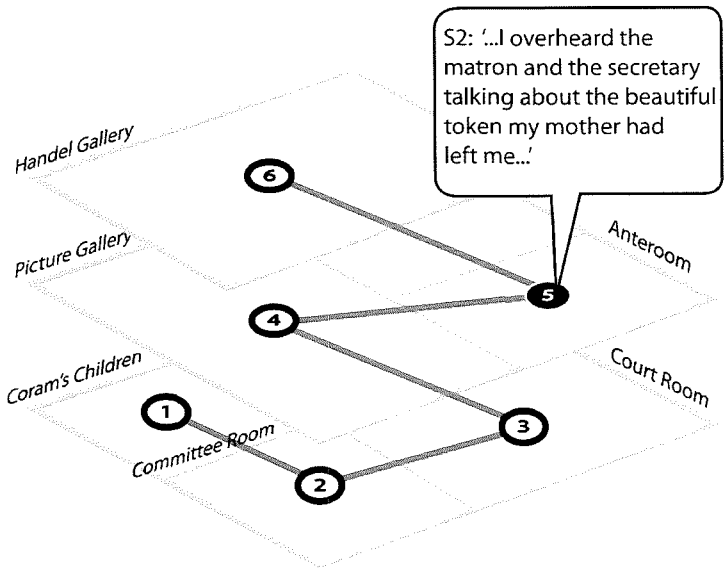


Figure 8.3 Students' complete trail through the Foundling Museum, with one stop highlighted and excerpted.

This trail differs from those in previous studies in that there is one stop per room, each stop defined as a discrete recording; as the Foundling Museum is small, six stops encompass most of the museum. Each stop focuses on one or two artefacts, or on the room generally as a historic setting. The recordings in each case are in the form of a dramatised monologue or dialogue, referring sometimes to multiple contexts of students and artefacts. These contexts are discussed next, beginning with students' personal context.

8.3.3 The role of students' personal contexts in trail construction

As in the previous studies, the personal context refers to visitor's prior knowledge, interests and beliefs, as well as motivations and expectations, choice and control; it is shown highlighted in the TrACE model in Figure 8.4.

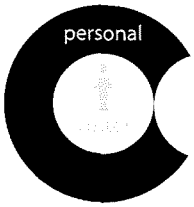


Figure 8.4 Portion of TrACE model with visitor's personal context highlighted in black.

In a trail such as the one in this study, the visitor in the TrACE model seems to be split: even if the students are each treated as an individual visitor in the model, each assumed a dramatised historical character, with its own personal attitudes, experience and motivations. The characters were not museum artefacts, but mediated the students' (and subsequently listeners') encounters with artefacts and their contexts. The characters were embodied by the students, and therefore inseparable from the students' personal contexts; they inhabited the social context of the trail construction activity in the form of language, but not the students' contemporary socio-cultural context; they emerged as a result of the students' encounters with artefacts; they were personal and social constructions which were part of the product of activity, mediated by technology; and they exist in the virtual space of the trail, yet are situated, and intended to be encountered, in the physical context of the museum.

While a character has thus touched nearly all parts of the TrACE model, as a construction which is part of the completed trail, it could be situated in the model in two ways: as a substitute, at times, for the visitor, encountering artefacts during the development of the activity from the perspective of the character's personal and social contexts; and ultimately, as a part of the final product, the completed trail.

The words of the characters are seen to stretch across the students' personal and social contexts. While this trail was the result of collaborative construction activity by the students, that each student adopted a consistent character throughout acted as a means to personalise the trail as well. For educator E2, 'personalisation' meant subjectivity and point-of-view — not in relation to the students but to their chosen characters:

> I think having a narrator might sound a bit too formal, and maybe a bit too impersonal. And we want to make it much more personal, because we're saying — we're having characters, and we're telling particular stories. (Recording VORC002, 6:30)

This became particularly important in the last trail stop, in the Handel gallery, which differs from the rest of the museum in that it does not contain rich fodder for stories, but primarily biographical information about the composer:

> S1: The thing is that Handel was also an orphan.
> E2: Yeah, you can mention that you admired him, you wanted to be like him, and you can take it from there and say, I don't know, whichever way you start with that, and say that he was actually an orphan, and say how he progressed in life, something like that. And then explain how the Foundlings admired him. Somehow make it more vibrant, 'cause the other rooms have a lot of substance, the other clips have a lot more energy, whereas this one is more information about Handel... You can personalise it a bit more maybe.
> (Recording REC18, 3:10)

Because the students inhabited historical characters, they made very few references to their own personal lives during the study. They necessarily had to draw upon their own knowledge and experience in order to 'personalise' the characters, and here gender is worth mentioning: It is notable that all the educators and students in this study were female, and subsequently each dramatised clip involves either an orphaned (female) child or a young mother. While none of the students mentioned

that they were either orphans or mothers themselves, they did come to realise that they shared some relevant personal experience:

> E2: And [the museum is] all about looked-after children as well, and there are plenty out there today. I mean, I for one have worked with looked-after children your age, and older.
> S1: That's what my mum does. She manages a team of social workers, at [institution name].
> S2: [Gasps] My mum knows your mum!
> S1: No she doesn't!
> S2: *My* mum's a manager of a social care home, at [same institution].
> S1: Is it?!
> S2: Yeah!
> S1: What's your mum's name?
> (Recording VORC002, 1:35:00)

The particularities of the characters were also based on the students' encounters with artefacts, other resources, and the museum environment itself, as well as their own negotiations: their discussions about who would adopt which character first centred on whose voice sounded the youngest or oldest. But in deciding who would play the governess, the discussion turned to issues of social class:

> S3: We don't have to talk posh do we?
> E2: Uh, *can* you talk posh?
> S3: No
> E2: See, the other day you were not the posh one, you were a prisoner.
> S2: But the thing is yeah —
> S1: I can talk posh.
> E2: You have to talk *some* posh.
> S2: I thought our project was just to get in and get it ruled
> E2: What?
> S3: Teenagers
> S2: Young people, teenagers. If you start talking posh, they're just gonna get bored.
> E2: Yeah, but you too. You're not posh anyway. You're poor girls.
> S1: So, we'll be like, talking like 'Yeah, so, I went down the pub and he was all like...'
> E2: Yeah, exactly. Exactly, actually, yeah. But you — she is a governor.
> S2: But it wouldn't really make sense, because she's in the 17th century, and we're talking ghetto, and she's talking posh.

S1: But no, it would, because that's like now, we have posh people now, and we still have —
S2: But they don't live in the same area.
S1: Yeah, *we* don't live in the same area neither. It's only that I'm comin' across you because you're bringing your child for me to look after. That's the only reason.
E2: God, you're into the character already!
S1: Yeah!
(Recording VORC002, 56:45)

This is where the students' personal context merges with their social context, the latter being discussed in the next section. In summary, the students' encounters with artefacts were not only shaped by their own personal contexts, but shaped *into* personalised, fictionalised characters in a process of personal and social construction. While the characters were undoubtedly influenced by students' individual and shared personal experiences, in speaking through fictional characters, the students gave up their own personal interpretations of artefacts. Thus, at times during the activity, the characters can be substituted for the students in the TrACE model.

8.3.4 The role of students' social context in trail construction

This trail consisted in large part of links between the social context of the students (as co-constructors of the trail) and the social contexts of artefacts (as illustrative of the history of the Foundling Hospital). The social conditions of the activity have been described: the students constructed the trail as a narrative, creating characters by navigating the museum together, with and without the educators, through discussion and negotiation. The horizontal division of labour was also described: each student developed a single character, and they negotiated the storyline together. While the students were ostensibly in a position of power as creators, their activity was guided by adults, though in a less directive manner than in the previous study.

It was also discussed in the previous section how students' individual and shared personal experiences in contemporary society helped them make history more accessible to listeners of their trail — for example their knowledge of looked-after children. They necessarily brought the characters to life — personalised them — by making them somewhat like themselves, for example by making them similar in age:

E2: How old is she now?
S2: She's old enough to be a servant, like around 15....
(Recording VORC003, 1:02:08)

This was related to one of the Young Consultant programme's aims: to create a resource for other teenage visitors. One of the students' early ideas, subsequently abandoned, was to create a page for the museum on MySpace, a social networking web site focused mainly on contemporary music. But they had difficulty imagining that it could attract young people with the music of Handel, or even more recent music:

E1: Think of some music that you think would be appropriate, and uh, I know that for example Handel has a museum as well as the Foundling Museum, but Jimi Hendrix lived in the same building as Handel. So, sort of remixes of Handel with Jimi Hendrix....
E2: Do you even like Jimi Hendrix at all?
S1: I don't even know who that is.
E1: He's slightly closer to your generation than Handel, but, like, was he in the 1970s?
E2: Yeah, yeah
S2: I wasn't even born until 1990
(Recording VORC002, 1:40:20)

By focusing solely on the trail and not creating a MySpace page, the three students gave up trying to contemporise the museum, and instead immersed themselves in the historical context of their characters. It became an individual and shared effort to come to terms with the original social contexts of the artefacts, and to convey these in the contemporary medium of the audio trail. The trail was thus intended to immerse the listener in historical narrative, while in the physical context of the galleries and artefacts. This was done primarily through language, which is discussed below.

First, I revisit the distinction in the TrACE model between the local social conditions of collaborative trail construction, and the broader socio-cultural context in which it takes place. As discussed, the model depicts a single visitor's encounter with a single artefact. In Chapter 4, multiple visitors encountering an artefact were discussed as sharing a physical context with each other and the artefact, and a social context if they are visiting together, as shown in Figure 8.5.

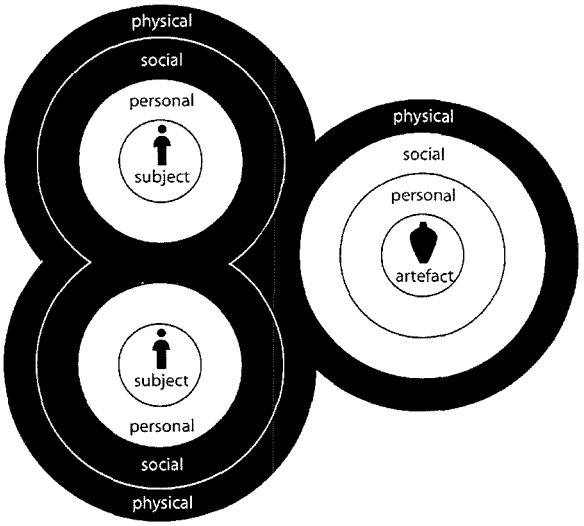


Figure 8.5 Initial version of TrACE model from Chapter 4, depicting multiple visitors in shared social context, encountering a single artefact in a shared physical context.

It is worth reviewing the assumptions behind the notion of the social context employed in the model. In Falk and Dierking's original Contextual Model (2000), as detailed in Chapter 2, this is termed the 'socio-cultural context,' being grounded in anthropology and social constructivism. The authors' (2003) Assessment Tool, derived from the Contextual Model and utilised in the first study in this thesis, was designed to encompass visitors' interactions inside and outside their social group, as well as within the broader contemporary cultural context. Yet this was conflated with what Falk and Dierking term the 'personal and cultural context' in the Assessment Tool, since a single visitor's personal context invariably contains cultural influences.

This conflict might be clarified when the notion of activity is introduced. In my model, activity is local to the physical context of the museum; while the trail construction process (or any other goal-driven activity) could be started or completed outside the museum, the model depicts in-museum activity only. By contrast, broader cultural influences are part of visitors' personal contexts, as evident in this study: while the three students were the same age and lived in the same city, their cultural backgrounds and influences were inevitably different. The educators' cultural contexts were even further removed: they were a decade or so older, and E2 was a Greek national, for example. Yet they all came together to collaborate on the social activity of trail construction. Their collaborative social activity is local, while their cultural context remains distinct and personal. Thus visitors' social

context can be said to refer to local activity, whereas broader cultural influences remain part of each individual visitor's personal context.

The role of the educators in this local, social activity must be clarified. From the perspective of the students, the educators were a fixture of the museum, for they were never encountered by the students anywhere else. Yet they were not fixed in each artefact's physical context, rather in the museum generally. They were thus analagous to tools and other resources provided by the museum; therefore their place in the model is with 'museum tools.' Luckin (2008) groups people and tools which assist learners as part of an 'ecology of resources'; thus 'museum tools' could be renamed 'museum resources' to broaden the category, while also keeping it distinct from visitor-carried tools. However, in this study such museum-provided resources were not limited to fixed artefact labels: they included a printed guidebook as well as the educators, all of which could move with the students through the different physical contexts of individual artefacts. Similarly, the digital audio recorders, previously considered part of the visitor's personal context in the model, were here provided by the museum, and while carried and used by the students, never left the museum.

A simple way to address this in the TrACE model is to create a broad category of mediating 'tools and resources,' as shown in Figure 8.6, and to then subsume fixed tools, such as artefact labels, into the physical contexts of artefacts.

Figure 8.6 Iterated TrACE model with mediating tools and resources highlighted in black, encompassing museum-provided resources such as educators and guidebooks, as well as visitor-carried tools.

Students' use of language and dialogue during trail construction

In the TrACE model, dialogue is considered part of visitors' (local) social context; it is not necessarily always in the form of dialogue between co-located visitors; in the first study for example, solo trails were created by individuals using portable audio recorders. In all cases however, the social context of trail construction generally remains fixed throughout the activity; for example in this study, while individual educators and other people came and went at different times, the activity remained, overall, a collaborative trail by definition.

As in the first study, the trail constructed in this study is constituted solely of spoken language. However, in the first study, trails were mostly disconnected interpretations of individual artefacts, without clearly defined goals or themes. In the second study, the 15-second time limit on recordings imposed by the technology prompted students to choose their words carefully, rehearsing and/or scripting their recordings. In this study, the activity had an explicit goal: the trail was to be constructed for other visitors. I suggested keeping each stop to around two minutes in length, and the students generally followed this guidance. As in the previous study, they carefully scripted and rehearsed each recording.

As discussed previously, the students struggled with trying to portray historical speech and different social classes through speech, in order to lend authenticity to their dramatisations. E2 favoured avoiding this, as revealed in a conversation with me early on in the process:

> What is so tricky is to try and match the sounds of the 18th century, in terms of accent and delivery and everything. And since we don't have enough time to learn all of that, I'd rather they just speak normally.... It takes a lot of research to actually write a script about how people would express things — it's not the same language, not the same expressions.... (Recording REC19, 5:30)

Also as discussed previously, the students, mindful of their goal of creating a resource for young people like themselves, initially aimed to contemporise the museum, not only through music but also language and dialect:

> S2: So we gotta think about the little things now. We've got a main one.
> S3: There's the Handel room upstairs, that we just came from.
> S1: Yeah that man, the musician.

> S2: We shouldn't really say much in his room, just have his music. I mean really, basically yeah? Have, like, tunes in the background, like tunes from now. But with his songs going through it. And like you was saying, not with a posh accent, but, like, ghetto accent. (Recording VORC001, 1:00)

However, as characters were negotiated and the story developed, the students 'got into character' (to use the theatrical term) and eventually abandoned the idea of contemporising the trail through either language or music. For example, as noted previously, S1 claimed 'I can talk posh,' and E2 exclaimed, 'God, you're into the character already!' (Recording VORC002, 56:45). In the completed trail, S1, as the governess Mrs Copperbottom, introduces the Handel room as follows:

> My good friend Handel is an absolutely fabulous musician. He helped fund our hospital by making awesome concerts. He is an inspiration to a lot of our children. He was actually an orphan, and was in a similar situation to some of the foundlings at the hospital. [Completed trail, stop 6]

This clip thus contains language believed by S1 to be 'posh' (e.g., 'absolutely fabulous'), yet also language which is unwittingly contemporary ('awesome concerts'). It thus links the personal context of S1 with the personal and social contexts of the artefact; here Handel takes the place of the artefact in this trail stop, or more properly 'object' in terms of activity theory, and the clip refers to his attributes (personal context) and social (historical) context. This relation is shown in Figure 8.7.

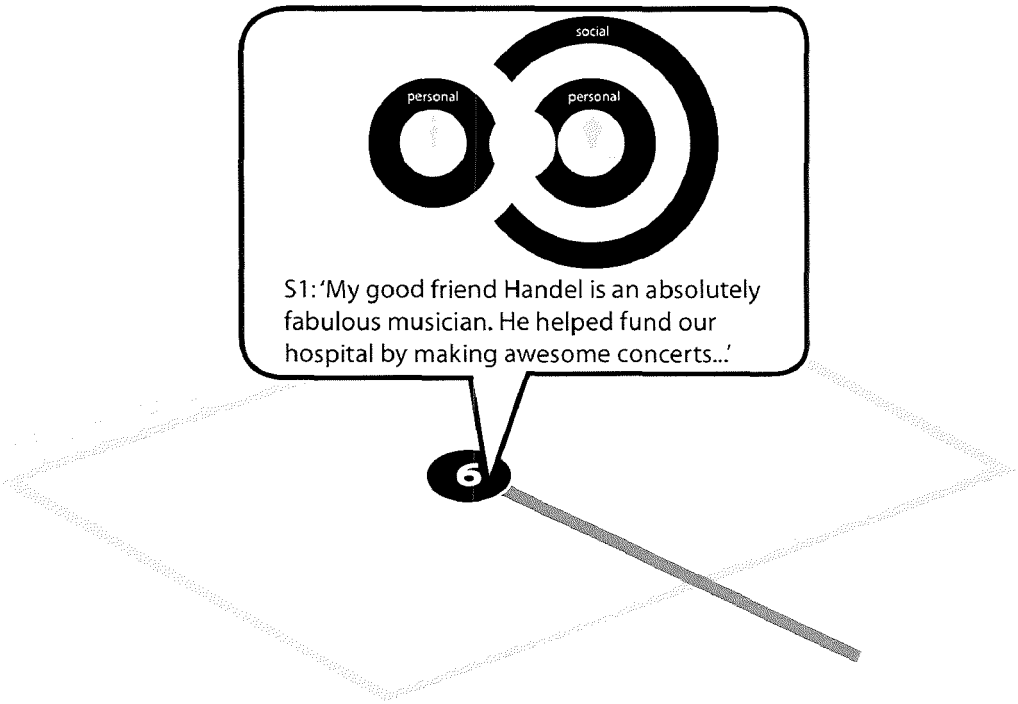


Figure 8.7. Trail stop 6 illustrating connections between personal and social contexts of visitor and artefact, highlighted in black.

The students thus adopted and adapted historical language for the audio trail, just as some students in the previous study adopted the language of science. Here they repeated facts from museum labels and the printed guidebook, but placing the narrative in the form of a drama enabled them to embellish the factual history with fictional histories. While in the previous study, students interviewing each other was seen to be effective in terms of meaning making, in this study, dialogue between characters could be viewed as analogous. For example, in the completed trail, the trail stop in the Committee Room contains the following dialogue:

> S1 (as Mrs Copperbottom): What are you doing in here? You're supposed to be in the courtroom.
> [sound of baby crying]
> S2: Yes ma'am. My name's Margaret Lanier, and I need you to take my child.
> S1: And how do you think I could help you?
> S2: You can give it everything that he needs. My husband's gone now.
> [Completed trail, stop 2]

The roles and relations of the governess and mothers bringing their children to the Hospital were conveyed in the form of internal, narrated monologues elsewhere in the trail. But dialogue makes their relation to each other explicit in the clip transcribed above, and enabled each character to relate her role in a more concise and naturalistic way. In a dramatised narrative, such question-and-answer dialogues could thus be considered analagous to interviewing in a science context.

Elsewhere, character monologues serve a similar purpose as the descriptions of plants in the previous study — in both cases, linking individual artefacts to their broader social context — and moreover in a 'personalised,' dramatic fashion in the case of historical drama, as in the following reference to a bracelet on display, which was left as an identification token:

> I was one of the many foundlings in this hospital. Like all of the other children I do not remember my mother, and have nothing of hers. When I was 12 years old, I overheard the matron and the secretary talking about the beautiful token my mother had left me. It has never been given to me.
> [Completed trail, stop 5]

Elsewhere can be found explanations (for example Mrs Copperbottom's reading of the rules to admit children in trail stop 1); comparisons (her comparison of the streets of London and the Hospital in stop 1); and reflection (Amy's reflection on her time as a child at the Foundling, having grown up, in stop 5).
While previous studies have looked at and for description, reflection, explanations, comparisons, and questions in visitor dialogue, in a visitor-constructed, fictionalised drama, these types of speech can be found in characters' monologues and dialogues.

The next two sections focus on the students' encounters with artefacts, as depicted in the TrACE model; specifically on how the three students bridged the personal, social and physical contexts of artefacts through their activity and dialogue.

8.3.5 Personal and social contexts of artefacts

The personal context of an artefact was defined in Chapter 6 as its individual history and attributes. In relation to the previous study, which was focused on observation of individual plants (their personal

context) as a means of classifying them into groups (their social context), here the attributes of individual artefacts were referenced as a means to explore their broader historical significance.

At the same time, the conventions of drama provided an effective means to 'personalise' the artefacts by attaching fictionalised stories to them — in effect, creating new personal contexts for them. Specifically, in the TrACE model this entails bridging the personal context of the artefact with the personal context — here not of the student, but of the fictional character. For example, in the Picture Gallery, the students were intrigued by the items that mothers were required to leave for their children as a means of identification. S3 selected one and built a narrative around it:

> Taking my little baby to the Foundling Hospital brought a lot of different emotions to me.... I was asked to leave a token to my baby for easy access to reclaim her. I left a black and white beaded bracelet in the token box. It was the only thing my grandma gave to me before she passed away.
> [Completed trail, stop 4]

This was then linked to a second artefact in the same room:

> My heart was torn apart, but at the same time I hoped her life would be better than mine. Seeing a picture of Thomas Coram, looking kinda nice with his big red coat, reassured me that my baby was in good hands.
> [Completed trail, stop 4]

Here, S3 skillfully used narrative to create a shared social context for two artefacts which were not otherwise obviously linked, within the same trail stop and physical context (here synonymous since there was one stop per room). This is depicted in the TrACE model in Figure 8.8.

Figure 8.8 TrACE model highlighting two unrelated artefacts linked in shared physical and social contexts in Stop 4 of the trail.

This is the very definition of trail construction, and shows how narrative provides a link through every part of the TrACE model. Narrative stemmed from the socially-negotiated goal, for the participants agreed to create a dramatised trail. It touched the personal and social contexts of visitors (S3's character, for example, being a personal construction, grounded in social activity). It developed through the students' activity, as they navigated the museum encountering artefacts. It was mediated by the audio recorder they used, plus the guidebook and fixed interpretation in the museum, as well as the support and assistance of the educators. It linked individual artefacts in a shared social context. And it took the form of a goal-driven product, the completed trail, which, as defined in the previous study, is a re-situating of artefacts from a physical to virtual context (in this case the digital audio recordings).

In the first study, the iconic architecture of Tate Modern was viewed as an artwork itself by the participants; here the Foundling Museum is viewed as integral to the history it represents, due to its location near the original Hospital, and to the original interiors which have been transplanted inside. The role of the physical context is explored further in the next section.

8.3.6 Role of the physical context in trail construction

The students approached each room of the museum essentially as curators: the re-created period rooms (Court Room, Committee Room, Picture Gallery, anteroom) served as sites for historical re-enactment, and the thematic galleries (social history gallery, Handel room) were treated thematically. As noted, one recording was done for each room, and each recording addressed either one or two artefacts, or the theme of the room generally. In four of the six final recordings, the students direct the listener to particular artefacts. More broadly, they considered how visitors would navigate the museum as a whole, and by extension how linear the narrative should be.

In their initial tour, the educators led the students through the museum the way most visitors navigate it. This started in the social history gallery ('Coram's Children'), which E1 described as follows:

> This section here is all about opening the Hospital and why they did it. These four pictures are all by this artist Hogarth, and they all tell you about what life was like outside the hospital. And this, *Gin Lane*, it's the one we've got a giant picture of it downstairs. You can imagine all sorts of sound effects happening there, of life if you didn't bring your child in here, or what life was like for the poor outside. So if you wanted you could incorporate a bit of it... (Recording REC14, 9:15)

Later, in the education room (where the large print of *Gin Lane* hangs), the students discussed what to record in, and about, the social history gallery:

> S1: From the childrens gallery I've done first — I think the first thing that needs to be talked about is the population of London, on that little map thing. Because you actually get a sense of what it was like, see what it looked like.... Then, yeah, go on to the print and picture wall thing, where the pictures are on the wall... And then you can actually see how bad their lives were. Lead them on to that.... We want the model of the Foundling Hospital to be included in that room. Do we want the lottery thing in that? From that room, do we want it, yes or no?
> S2: It's the least important thing.
> S1: It's the least. OK, so we don't need that.
> S2: It's the least important thing, BUT we could bring it in when Margaret goes back to the hospital and goes, 'I tried two years afterwards.' The lottery, it was done by luck.

S1: True. But we're only gonna pick like one or two things from each room... OK, come on, next one. So we want the printed pictures on the wall, how London used to look. Do we want the population of London, the map thing?
S2: There could be a little bit of it, and then the model.
S1: Do we need it?
S2: We don't need it, but it would be a bit —
S1: I know, we need this. All right then.
(Recording VORC002, 0:10)

In the their discussions, the students initially envisioned *Gin Lane* as the first trail stop, and the model of the Hospital in the same room as a second stop. Ultimately they decided on one stop per room, in this case incorporating the two artefacts. S1, in the fully developed 'posh' character of Mrs Copperbottom, skillfully used the artefacts to contrast the conditions of London with those of the Hospital in the completed trail:

If you walk to your right of the room, you will see a picture of *Gin Lane* [horse sounds]. Hogarth's interpretation is exactly correct [pig sounds]. Imagine just lying there in the street [coughing sounds], seeing and smelling dead people. Eww, how disgusting [baby crying]. Loads of children are abandoned and not looked after by their neglectful parents. How sad.... If you walk around the wall behind you, you will see what our hospital looked like [birds singing]. Don't you think it's a grand building? Well I must say it is myself. I've been the governess of this hospital for an extremely long time, and I know they're trying to get rid of me — I've heard the rumours myself....
[Completed trail, stop 1]

After the initial tour with the educators, the students were given their own space — the education room — in which to work on their trail. However, they soon realised the importance of being separated from the physical context of the galleries:

S2: What's the Committee Room again? What room was that?
S1: I think that's the room that we liked.
S3: That's the Court Room maybe.
S1: Oh. I don't know then, I forgot.
S3: It's next to the Court Room.
S1: The other one, that had the table there? That you sat on, yeah?

S2: Why can't I sit on it?

S1: Because it's, authentic furniture.

S2: Look, in that room, we could just basically say, 'That table is unique, and one of a kind,' blah blah blah, and then go to the picture — one picture. What pictures were there?

S1: Actual pictures of like —

S2: The Court Room?

S1: Yeah. And what was actually in there when the building was there. So....

S2: We could have like, someone saying, 'Oh there's a picture of me when I was younger,' you know, on the trail? 'There I was, my mum was bringing me here...'

S1: Mm, yeah yeah yeah.

S2: Well, because we couldn't really remember what we saw in the rooms — what room was what — so I picked some other time we could go around and take notes in the room. We can't remember anything we saw.

S1: No. We can remember —

S2: I think we should decide when we're in the room. 'Cause now I can't really see what we decided about.

(Recording VORC001, 1:00)

In the end, they decided not only to revisit each room to take notes, but to work on and record each trail stop in the room for which it is intended. This enabled them to give precise directions in the recordings (for example, 'If you walk to your right...', Trail Stop 1), to see the artefacts they refer to in the recordings, and, as they said in the post-interview, lend more authenticity to their dramatisations.

In the previous study, there was a disconnect between physical locations and trail stops, because the trails were regarded as a place to gather evidence to support hypotheses in a science learning context. Here however, the explicit goal of making an audio trail for others to follow — in a physical as well as narrative sense — effectively linked the trail directly to the physical contexts of the artefacts.

These physical contexts of artefacts must be distinguished from the overall physical context of the museum generally. In all the museums studied in this thesis, the physical context of the museum can be assumed to surround the activity space in the TrACE model, as depicted in Figure 8.9; goal setting and completion of the outcome may or may not take place in the museum, as they did in this study.

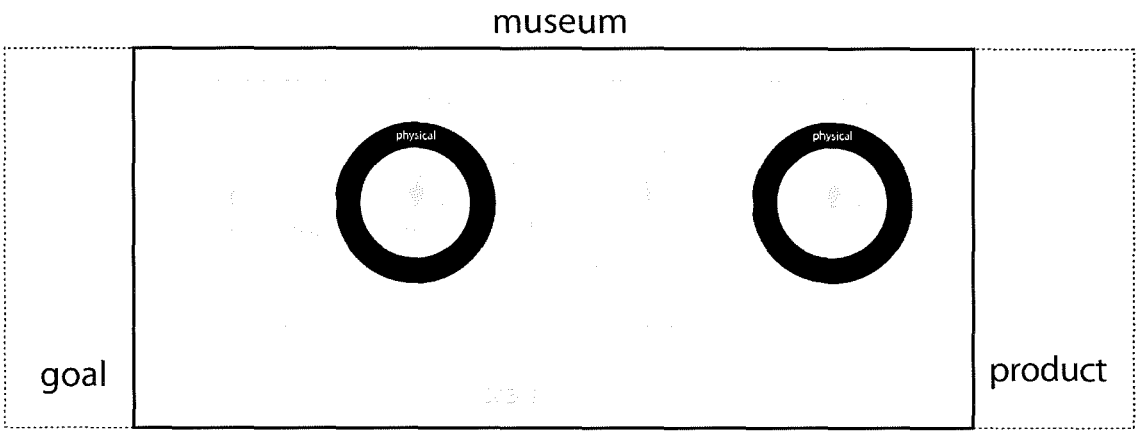


Figure 8.9 TrACE model with surrounding museum context, distinguished from the physical context of artefacts, which are highlighted in black. Dashed lines are intended to show that goal-setting and outcome completion can take place in or out of the museum.

In the case of the Foundling Museum, the overall museum context is closely linked to the social contexts of artefacts, defined in Chapter 6 as the historical social and cultural conditions in which they were created and used; a particular display or exhibition was defined as the re-contextualisation of artefacts in a shared social and physical context. As a small history museum with a singular overarching meta-narrative (the story of the Foundling Hospital), the Foundling Museum generally serves as a single exhibition. While it holds temporary exhibitions unrelated to its meta-narrative, the important role of its architectural interiors ensures that the building as a whole serves the historical meta-narrative as an artefact itself.

With a clearly defined goal of creating an audio trail through the museum, and thus about the museum's meta-narrative, the students' activity was mediated by the tools and resources they used, including the audio recorders, pen and paper, and museum-provided resources. The role of these mediating tools and resources is discussed in the next section.

8.3.7 The role of mediating tools & resources in trail construction

In Section 8.3.4, the category of mediating tools in the TrACE model was expanded to encompass both visitor-carried and museum-provided tools and resources, which in this study included portable digital audio recorders, paper and pen, a museum guidebook, and human resources — specifically the

two museum educators who worked with the students. As mediating resources, museum educators can act as a direct link between visitors' and artefacts' social contexts, and were discussed in Section 8.3.4 in relation to students' social context. This section therefore covers the audio recorders as a primary tool for trail construction, plus paper and pen and the museum guidebook.

The importance of audio has run throughout this thesis, from the individual and collaborative trails created using audio recorders in the first study, to the prominent role of audio observed in the previous study, even considering its limitations in the mobile phone-based system and the availability of other media for data capture. This study therefore centred on audio recording as a mediating means, and an audio trail was proposed as a product for the students to construct. However, the students themselves were apprehensive about it, instead initially wanting to do a single drama performance in the museum, as E1 explained in the post-interview:

> They were happy for us to take photos of it, they were happy to perform, but they were not happy to have their voice recorded. So we talked about that in the morning... but by the afternoon they were like, 'Okay we'll do it.'
> (E1 post-interview)

I proposed purchasing three small, inexpensive and simple recorders so that the students could use them as they wished over the course of the week, in order to help them become comfortable with recording and hearing their own voices. I also suggested recording their discussions in order to further increase comfort, as well as for my own research data collection. The resulting recordings provide evidence that the students did attain a comfort level, helped by the educators, as shown in the following discussion:

> S1: Is this really mad to do this? No it isn't. [Picks up recorder] All this time it's been recording. Re-CORDING! [Into recorder] So we've basically come to the conclusion that me, [S1], I'm the governor, [S2] is the child, and [S3] is the mother. And we are going to have the mother bring the child to the Foundling Hospital, in the courtroom. And we're going to make more decisions in a moment or two. [Puts recorder down]
> S2: We have to have the script together, with sounds. So think of everything — this line, sound, that line, next....
> S1: But we've got to think of exactly what they're gonna say —
> S2: We could just make it up for now.
> S1: Kind of improvise, but kind of have lines as well

E2: But then again, that's why we have a recording as well [picks up recorder]. We record everything you rehearse, so later on you listen back to it, instead of having to write down every line....
(Recording VORC002, 1:16:10)

The students did record rehearsals and several early versions of their trail, and listened back to them. As in the previous study, there was initially laughter and horror at hearing their own voices. But in this case because the students used the devices over the course of a week, instead of a few hours as in the other studies, they soon got over this. There were no significant technical problems in using the recorders, and once they learned to record and play back, they used them continuously, either to record their discussions, or for rehearsals.

They did not use the recorders as in the first study (recording their own interpretations of artefacts as they navigated the museum), nor as in the previous study (to collect data or evidence as part of research). Their narrow interpretation of the recorders as tools was related to the narrow definition of the goal: this was to be an 'audio trail' and the devices they were given were for recording the trail, as well as for visitors to use to play back the trail as well. Thus, even more so than in the first study, here the device was closely tied to the trail definition and product; specifically in this case it was not a trail of artefacts visited, but more clearly defined as a trail which would help *other* visitors in their encounters with artefacts.

Paper-based tools and resources

To that end, the students only used the devices for rehearsals and recording the final trail; the continuous recordings of their discussions were done at my suggestion, and the students did not listen back or use them. Instead, they took notes on paper while navigating the museum, which they used to write scripts and outline the structure of the trail. This reflects a difference in how the recording technology was framed — merely as a tool to create the audio trail — in contrast to the previous study, in which the system was introduced as a research tool to help students capture data and evidence. Additionally, the affordances of paper — its nonlinearity, foldability, ability to take a variety of written and drawn marks — could not be matched by a system such as the one used in the previous study, for example for creating mind maps.

The students worked carefully on what to say and how to say it, as in the previous study. As before, they used paper and pen to take notes and to write scripts which were read into the recorder. The museum educators provided large and small sheets of paper for the students to use as they wished. The result was several pages of notes, several versions of scripts, plus two large mind maps and a large diagram of the structure of the trail. (These appear in Appendix 11.) According to Hooper-Greenhill (2007:82), when given the choice, older children in museums tend to write rather than draw, and that was the case here: there were few drawings, most of them doodles.

In contrast to the first study, in which the audio recorder was used in informal museum visits, the students' tool use in this study was closer to that in a school project. As they went around the galleries without the educators, they wrote notes such as the following:

- 75% of children born in London died before they were 5
- The musician Handel gave annual benefits to the Foundling
- William Hogarth was a governor at the Foundling Hospital
- In the 18th century only one third of all children presented to the hospital were admitted
- 1344 children were accepted by the Hospital between 1746 and 1756.

(Student notes, page 23-24)

Some of this information made its way into the completed trail. Early versions of their scripts were written in the galleries, and often contained facts copied from text on the wall, sometimes even with instructions to themselves, as for example in the following early draft:

> London 17th August 1756. The streets of London had distinct differences between the wealthy and the poor. (Read out things from the wall)
> [Student notes, page 30]

The guidebook, provided by the educators, was similarly used as a source of information for the trails, as for example in the following discussion:

> S2: I want to find out more about Handel, some more information about him and his music.
> E2: Do you want to check the guidebook?
> S1: [reading]
> E2: What does it say there?

S1: Um, 'Concerts were another effective method of raising money for the building fund, and the hospital became famous for performances organised and conducted by Handel.'
E2: OK, but at this stage it's Amy talking, and imagine if you're a foundling in the hospital, how far does your knowledge go?
S2: She could talk about, like, 'We had concerts every last Saturday of the month, and Handel was a famous composer....'
E2: All right, write down, not what it says there, what you just said to me, how Amy expresses herself....
(Recording VORC003, 48:33)

The above extract marks a shift in the students' work, early on in the process, away from simply repeating information, to developing the dramatised story. On the written notes, the words 'emotion' and 'improvise' are written in large letters, as well as 'Change dialect,' and 'Continue to do over the top, allowing emotions etc to stay on top.' [Student notes, page 16]

The two mind maps were created on large sheets of paper and oriented toward the narrative construction. One is titled 'What the main story is about,' with the proposed trail stops, and the other titled 'Sounds,' with sound effects desired for each stop. I observed them revising and referring to the 'main story' mind map during the trail construction process, and when recording the final trail to check the order and relatedness of the stops. They revised the 'Sounds' mind map as they thought of sounds to add, throughout the process, then used it on the last day when adding the sound effects; this is discussed further in the next section. I did not ask the students to make mind maps, and it is unclear whether they were prompted by the educators to make them; regardless, the mind maps proved useful to the students for visualising the overall structure of the trail.

When the students came to planning the last stop in the trail, in the Handel room, they found that the room differs slightly from previous ones in that it is primarily about the man and his music, and they negotiated how best to fit this in to the trail:

E2: Also, to be honest, we don't need to really expand on Handel. I mean —
S2: Everything in the room is about Handel though.
E2: Yeah, but everything in there is quite clear. You can sit down in a chair and listen to his music... and there's all of that, that says everything. I mean it's written there, why would you have to repeat that on the audio guide?
S2: If they didn't want to read

E1: In terms of reading, there's a lot of writing. And a lot of people don't want to read — to hear it, they'll more take it in. That might be a good idea, if you give them a bit of a background on who Handel is and stuff... Obviously Amy wouldn't know a lot about him, so that's where the governor would come in to give us some background....
S2: You could be like, 'He was a very close friend of mine...'
(Recording VORC003, 1:02:30)

This extract shows that the students were thinking about the audience for, and purpose of, the trail. This was aided by the educators, E1 for example implying that the trail could act as a replacement for, not just a complement to, written interpretation in the galleries. The next section focuses more closely on the completed trail and how the students and educators thought about it as a medium and a product, in relation to their original goals.

8.3.8 Completed trail and its relation to the goals

As a final step in analysis, I now focus on the completed trail, and compare it with the original goals. As discussed in the previous section, at the start of the project the students and educators had somewhat conflicting goals, the students aiming to perform a one-time drama, and the educators wanting an audio trail for their museum since it did not have one; this appeared to be a clear conflict of short-term versus long-term goals. In their initial discussions, they reconciled this conflict by agreeing to incorporate the drama into the trail. At first the students envisioned this as only a small part of the trail, but E1 prompted them to think about the audience, the value, purpose and structure of the trail, as evidenced in the following extended extract from their discussion. A turning point can be precisely pinpointed in S2's revelation, in the line marked with an asterisk:

E2: As an audio trail, say if someone comes into the gallery, listening to the audio trail, is downstairs, at the entrance, um, you have to think of the spaces as well. The gallery. Rooms. Say, if I'm here, where do I listen when I'm, uh, at the top of the staircase?
S2: Yeah we thought about that. On the staircase we basically, just narrate, in our opinions, the pictures. That's what we're gonna do on the staircase. And in the lottery room —
S1: We're gonna like, go to the different rooms, talk about stuff in the different rooms. But then we want our story to be in like the, um —
S2: Courtroom

S1: — courtroom. So we could like, go back to the drama piece in the courtroom. So we could kinda introduce it then, but then slowly come out of it when we move on to the next room. So it's on the audio trail, but it's like, in it, if you get what I'm saying.
E2: So your characters are only coming in when you are in the courtroom?
S2: Well yeah, we got different characters in the other rooms, but the main story —
E2: — is happening in the courtroom.
S1: Yeah.
E2: So basically, when someone is listening to the audio trail when they're in the courtroom, that will take a while.
S2: Basically, we can't really say much in other rooms, so we wanna focus more on the courtroom.
E2: You can expand. What about the story of the child when she's grown up?
* S2: That could be the whole way in! You know those pictures around? It could be like, 'There I was.' Because they can't really see us. So 'There I was when I was 14, doing exercises' — you know in the hallway, those exercise bars?
E2: Right. No I'm just trying to think of it as separate little stops in the audio trail. As someone comes in and listens to story 1, and story 2, and 3, somehow —
S2: I don't get that part.
E2: So, you want your drama to be with the mums coming into the hospital, presenting their petitions, being accepted or being rejected. OK. So that's a drama, and we can incorporate that into the audio trail. But imagine that a person comes into the gallery and listens to your audio trail. And they start from the entrance to the gallery. And they press Stop 1. I'm listening to Stop 1. How would that start? What would it be? Who talks? Who's the character that's opening the audio trail?
(Recording VORC001, 16:30)

This prompted the students to come to terms with the technicalities of an audio trail, since they had never taken a museum audio tour before. In terms of activity theory, a conceptual breakdown can be identified in the extract above, when S2 says, 'I don't get that part,' in reference to how the stops in an audio trail work. S3 then reconciled this by recognising that the digital recorders were familiar to them as MP3 music players:

S2: When you say stops, I really don't get it.
E2: Oh, yeah —
S3: Like tracks on a MP3

E2: Yeah. If you take an audio guide and you press 1, you listen to a description of one picture, say.
S2: So that's one stop.
E2: Yeah. You go to another picture and that says, 'Press number two on the audio guide.' Press number two and you listen to audio about that other picture. And that's stops.
S2: Oh, yeah.
(Recording VORC002, 37:38)

Linearity in the trail

The students also had to come to terms with linearity, and S2 related to S1 her knowledge about MP3 players, in what can be identified as a conceptual breakthrough:

S2: No I think yeah, it shouldn't be in order, 'cause you know with MP3 [picks up recorder], you can save with different names, like 'The foyer.' But for the — what room was this?
S1: The gallery room
S2: The children's gallery room. For that part it starts like that. It has a different thing for it [taps recorder], a different slot.
S1: Where do they exactly start? Can they click on which one they want to start on?
S2: Yeah, whatever room they're in, just click on it.
S1: Oh, OK. Ohhh.
(Recording VORC002, 24:15)

In the end, the students balanced the nonlinearity afforded by the technology with the linearity of the storyline, capitalising on the fact (stated by E1) that because the museum is small, most visitors navigate it the same way. Thus in the first stop of the completed trail, the governess Mrs Copperbottom introduces the museum in the social history gallery which performs the same function, and is situated next to the museum entrance. The trail stops proceed to each room, and each floor. One of the final tasks the students undertook was to have navigational directions inserted into the clips; thus for example the first clip begins with 'Start by going into Coram's Children on the ground floor,' and ends with 'Now walk through the door and into the Committee Room.' They decided that to have the characters state these directions would break the drama, and therefore asked me to record the instructions. Each track was named with both a number and the name of the room to which it corresponds.

The use of a linear narrative served to tie each stop together — an issue raised in the first study. Here, for example, characters recur in subsequent trail stops, their stories continue, and references are made to previous stops.

Role of sound effects in the trail

The students' skill in constructing a compelling drama extended to their use of sound effects. On the final day of the project, E1 brought in a sound artist, who sat with the students around his laptop. The sound artist played a variety of sounds which the students had specified on their mind map, and they chose the ones they liked best. The sound artist did not have any other significant input into the trail. That the sound effects were skillfully used by the students can be seen for example in the first stop in the completed trail, when S1 (as Mrs Copperbottom) introduces the trail, and the museum:

> If you walk to your right of the room you will see a picture of *Gin Lane* [horse sounds]. Hogarth's interpretation is exactly correct [pig sounds]. Imagine just lying there in the street [coughing], seeing and smelling dead people. Eww, how disgusting [baby crying]. Loads of children are abandoned and not looked after by their neglectful parents. How sad. If you walk around the wall behind you, you will see what our hospital looked like [birds singing]. Don't you think it's a grand building?
> [Completed trail, stop 1]

The picture painted by audio is thus not restricted to spoken words, for the dirty streets of London are illustrated for example with pig sounds, and contrast sharply with the sound of birds singing when the Hospital is introduced.

Relation of product to project goals

Returning to the original goals of the study, students and educators all felt they had met their original goal and produced an audio trail which was both informative and enjoyable. The students were able to develop and perform a drama, and the museum got a finished audio trail, complete with sound effects, which was put back onto the MP3 players for visitors to borrow at the reception desk.

The MLA described the audio trail project in its final report as follows:

> Young Consultants at the Foundling Museum created an Audio Trail where characters gave a short monologue or dramatic scene with music and sound effects in a number of different room settings. The resource is downloadable from the website and available to visitors at reception. www.foundlingmuseum.org.uk/Audiotours.php (Larsen, 2008)

By contrast, the TrACE model used in this study illuminated specifically how the students negotiated a goal with museum educators, and approached that goal through the activity of navigating the museum, encountering artefacts, and constructing characters and a story from them. It highlighted how students' and educators' personal and social contexts influenced the trail construction and the character and story development. It showed how tools and resources helped bridge the student's contexts with those of artefacts, and it provided a means of analysing the completed trail in relation to the stated goals and the process of development.

8.4 Revisiting the research questions

In keeping with the overall aim of thesis, this study involved a different visitor type, museum and topic from the other studies, but returned to audio recording technology, and focused specifically on the goal, product and structure of the trail construction process. In this section I revisit the research questions and the relevant points raised at the beginning of this chapter.

Research Question 1: (How) can visitor-constructed trails support meaning making in museums?

After the trails concept was not well understood in the previous study, because it was not framed or communicated well by the educators, this research question was made a central focus of this study. As such, construction of an audio trail was the main goal made explicit and agreed by all participants. Once students understood the sub-concepts of trail stops and linearity, as discussed in the previous section, the evidence from observation, the transcripts, and not least the final product, suggests that the trails concept effectively structured the activity.

This research question addresses visitor meaning making, locating it epistemologically in the bridging of contexts between visitors and artefacts, specifically the personal and social contexts, as well as the physical contexts of individual artefacts, within the museum setting as a whole. As described in Chapter 1, this thesis does not intend to measure learning quantitatively, but looks at the process of trail construction, and qualitative aspects of visitor encounters with artefacts. On this basis, during this study the students engaged with the process, reconciling trail construction with their initial goal of performing a drama. Their encounters with artefacts, and with the galleries and museum generally, were shaped by contextual factors and made personally and socially relevant through their constructive activity and dialogue, into a coherent product. This is a positive response to the first question, *Can* trails be used to support meaning making in museums?

As to *how* trails offer support, a limited number of trail stops helped to constrain students' activity to a manageable level, and narrative played a significant role in trail content and linearity. As there is evidence for the value of narrative in art museums (Mitroff and Alcorn, 2007)) and science centers (Parry, 2008:185), it is reasonable to assume that a degree of narrative would suit trail construction in other museum types. This need not take the form of an audio trail in all cases, but is more likely related to how well-defined the structure and scope of the trail; and in this study the TrACE model was useful in terms of design as well as analysis of the activity. The technology, as in the previous study, also served to constrain the activity to audio only, and students thought about it not just in terms of how to effectively tell a story using audio, but also how the portability and nonlinearity of the devices would influence the listener's experience of the museum.

Another important aspect of the trails concept in this study was the constructive (or more accurately, constructionist) approach. This marked an extension of Peterson and Levene's (2003) concept of trails as resulting from aretefacts visited, with more attention, in this case, paid to the goal and outcome of the trail resulting from those encounters, reframing it to the students as a trail to be constructed for other visitors to follow. In this study, the goal and outcome served as 'bookends' around the museum-centred activity, as depicted in Figure 8.9. The incorporation of a narrative was students' and educators' interpretation of trail construction as an act of curation, and the students thought about how other young people would experience the museum through the trail they constructed.

Research Question 2: How do portable digital technologies mediate and support trail construction?

As in the first study, the portable digital audio devices in this study were closely linked with the goal of constructing an audio trail. In the first study however, trail stops were disconnected interpretations of individual artefacts. In this case, framing the trail as an act of curation, with explicit goal, product and audience, prompted the students to think about the qualities of audio as against other forms of museum interpretation, as well as the structure of the final product. Their understanding of aspects of the trails concept were aided by the use of a familiar technology; for example when the students realised that the device was a simple MP3 player such as they normally used to listen to music, this helped them understand the concept of trail stops and (non)linearity. This lends evidence to Gammon and Burch's (2008) finding that the design of museum technologies should relate to visitors' mental models of familiar technologies, as discussed in Chapter 2; in this case the finding applies to visitor-constructed technological products as well. While mobile phones were familiar to many of the students in the previous study, the design of the system was different than either students or educators had encountered before.

The students in this study recorded their trail construction process on the devices, as well as the trail itself, as suggested by me for the purpose of this thesis. They also used the device for rehearsing scripts, but not for recording their interpretations, as in the first study, nor for collecting data, as in the second study. This again was linked to the narrow goal definition, which in turn led to a narrow use of the devices.

As in the previous study, the digital recorders were used effectively together with paper and pen. As before, scripts were written on paper and read into the recorders. But unlike in the previous study, the recorders were not used to capture data to move it from one place to another; paper served this function. However, mind maps created by the students proved useful for visualising the structure of the trail.

Research Question 3: What is an appropriate model for the design and analysis of technology-mediated museum trails?

For reference, Version 3 of the TrACE model, as developed after the last study, is shown in Figure 8.10.

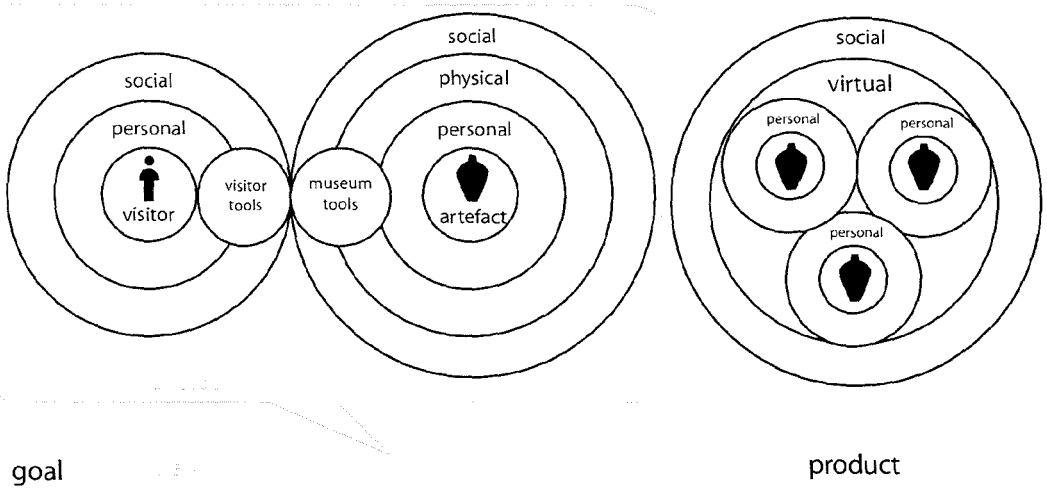


Figure 8.10 Version 3 of TrACE model as iterated after the previous study.

The model underwent changes during the analysis of data in this study, with important implications for the design of activities. The social context was recognised as local to the activity of trail construction, while broader cultural influences were seen to be part of students' personal contexts. The social context of students' activity is viewed as fixed throughout trail construction. The physical context was split, between the physical contexts of individual artefacts and the physical boundaries of the museum; goal-setting and product completion can take place either outside the museum, as in the previous study, or in the museum, as in this study. Conversely, regarding mediation, visitor-carried tools and museum-provided tools were combined with human resources into a single 'tools and resources' category, which is seen as mediating visitors' encounters with artefacts; only artefact-centred mediators such as text labels remain fixed to the physical context of artefacts.

The goal and product in the TrACE model relate directly to the activity of trail construction: the goal driving it, and the product a result. Narrative provided a way of linking every part of the model, from

the goal to the product, but did not alter any particular aspect of the model. Characters constructed by visitors were not foreseen in goal-setting, but formed a key component of the final product. However, in speaking through fictional characters, the students gave up their own personal interpretations of artefacts; instead of trying to contemporise the museum, the students immersed themselves in the (historical) personal and social contexts of their characters; paradoxically, this was viewed as 'personalising' the trail — to the characters' perspective, not the students'. Yet the students inevitably constructed the characters using elements from their own personal and social contexts. Overall, the dramatised, character-driven narrative in this study resulted in a trail which was both personalised and collaborative.

The final version of the TrACE model is shown in Figure 8.11.

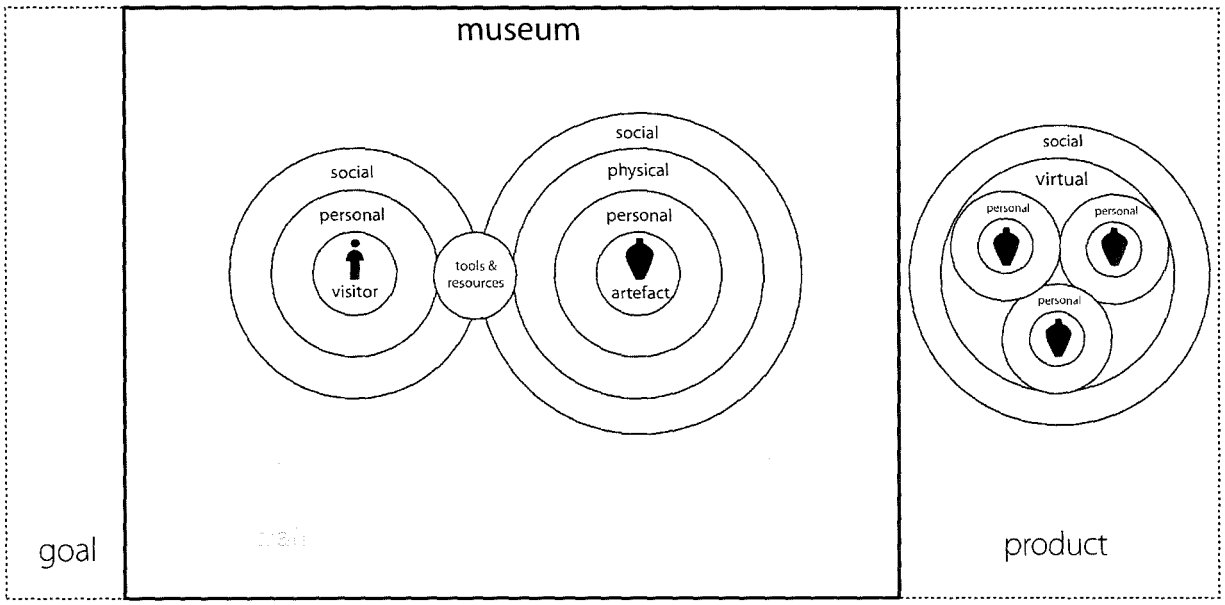


Figure 8.11 Final version of TrACE model.

8.5 Conclusion

This study has investigated the trails concept, technological mediation thereof, and the conceptual model for both design and analysis, in the construction of a narrative trail by secondary school students at a small history museum. It was found that the specification of a clear goal and product,

along with a narrow scope, contributed to understanding of the trails concept, with the form of technological mediation linked closely to the trail definition, and both dialogue and activity linked to the goal and product. Narrative played a prominent role in a history museum in this study, but could be expected to be as strong in other museum types; narrative linked all parts of the conceptual model, and resulted in a trail which was both personalised and collaborative.

This is the final study in this thesis. The next chapter concludes by revisiting the aims and research questions across all three studies, drawing broader conclusions and implications for design and analysis.

Chapter 9
Conclusion

This chapter concludes this thesis by reviewing its aims, and summarising the findings of the three studies conducted. It also outlines the main contributions of the research, discusses the limitations, proposes issues for further investigation, and outlines the implications for museum meaning making and technology design.

9.1 Reviewing the aims of the thesis

The main aim of this thesis was to explore how people make meanings in and from museums, as mediated by portable digital technologies. The focus was on activities which structure the use of technologies, not on the technologies themselves. One such activity — visitor-constructed trails through museums — was studied in depth, with attention to the design of trail construction activity, the appropriate amount of structure for such activity, the role of context(s), and how technologies mediate the activity.

The technologies of particular focus were portable digital technologies, including mobile phones and digital audio player/recorders. This thesis was aimed at understanding and structuring the use of digital tools with regard to meaning making, since such devices are now commonly carried by museum visitors. To museums, the democratisation of curatorial knowledge, accelerated by digital, networked technologies, is perceived as radical, and as a threat to their role as cultural authorities. Yet as noted in Chapter 2, the rapid spread of the Internet and of portable digital devices has not eroded public perceptions of museums' authority as arbiters of knowledge, nor has it reduced the number of

physical museum visits. Thus, one of the issues explored in this thesis was the balance of curatorial and visitor-generated knowledge desired by, and useful to, museum visitors.

In the review of the literature on museums and meaning making in Chapter 2, it was seen that different types of museum adopt different epistemological positions: art museums link knowledge to direct aesthetic experience, science museums view it in terms of abstract scientific concepts, and history museums relate it to cultural identity; these epistemological positions were explored in each of the three studies. Museums are artificial cultural constructs, built to house authentic, though de-contextualised, artefacts; the act of interpretation is intended to help re-contexualise them. According to Halloran, et al (2005):

> A story is not so much about the artefact itself, rather about how it came to be here and what is its relationship to other objects. There are many stories to be told and different perspectives from which they can be told, and these stories often overlap with others. We have further come to understand that there is seldom a 'true story,' as curators describe parts of their research to be almost like 'detective work.' Thus information exists in several layers. (Halloran et al, 2005:57-58)

In this thesis, visitor encounters with artefacts were investigated in the form of links between visitors' personal and social contexts and artefacts' contexts of creation and use. The main way that people make meanings in collections-based museums, generally, is through the act of interpretation, which in turn depends on individual, task and situation characteristics as well as cultural conventions. Thus, the theoretical perspective underlying this thesis was that of Falk and Dierking (2000), which situates meaning making in visitors' personal, physical and sociocultural contexts.

Portable digital technologies can be used at the site of encounter between visitors and artefacts, and Pierroux, et al (2007) propose that such technologies can help to bridge the contexts of visitors with those of artefacts. Yet as discussed in Chapter 2, complex technologies which merely deliver information to an already sensorally-rich museum environment can merely add to visitors' cognitive load, and are often less 'interactive' than many traditional educational activities. Therefore this thesis utilised simple, common technologies such as mobile phones and digital audio player/recorders, focusing on the design of activities around encounters with artefacts.

Based on the notion that making meanings in museums is related to connections — between objective facts and subjective experience, artefacts and visitors — the concept of trails, as originally defined by

Peterson and Levene (2003), situates meaning-making in physical and intellectual navigation, with technology used to capture visitor experiences and interactions, and to construct linear paths of 'learning objects' in spatial, temporal, and/or categorical arrangements. While some 'experience recording' technologies have previously been tested, and some trail-like activities implemented in museums, trails as such had not previously been the subject of pedagogically-grounded, empirical research.

This thesis therefore investigated the idea that a trail is a suitable means of connecting artefacts together by linking them in a visitor-generated construction, using portable digital devices as tools to help visitors interpret and re-contextualise artefacts. Trails had not previously been viewed by researchers as a visitor-constructed product; instead, trails were either created by curators for visitors to follow, or automatically generated from unstructured visitor navigation as a means of providing adaptive delivery of information. This thesis, by contrast, proceeded from a constructionist epistemology, in order to frame trails as both a conceptual structure and a deliberate product, to help visitors make meaning from museum visits. The trails concept was regarded not only as a means to structure visitors' activity in museums, but also as a conceptual structure for understanding visitors' activity, as well as providing a concrete product for focusing visitors' dialogue and meaning-making. In other words, this thesis investigated trails' value to both practice and theory with regard to museum meaning making.

In order to focus on the design and analysis of tool-mediated activities, the Contextual Model, as a theoretical perspective, was implemented methodologically using activity theory, specifically drawing from Kaptelinin and Nardi (2006) who propose studying goal-oriented technological interventions through analysis of their means and ends, the environment, cognition and articulation, and the development of activity over time. A conceptual model was developed, which incorporated and built upon the Contextual Model and the methodology of activity theory.

The specific research questions developed from reviewing the literature on museum meaning making, technology and trails were as follows:

1. (How) can visitor-constructed trails support meaning making in museums?
2. How do portable digital technologies mediate and support trail construction?
3. What is an appropriate model for the design and analysis of technology-mediated museum trails?

Embedded in Question 1 was a sub-question about the balance of curatorial and visitor-generated knowledge desired by, and useful to, museum visitors as they construct meanings from artefacts. Another sub-question, prompted by the methodological grounding in activity theory, was the extent to which visitors internalised the trail concept as a form of self-regulation, and conversely externalised it during trail construction. In Question 2 was the sub-question, discussed in Chapter 2, of how much the technology distracted from museum artefacts, versus how (and how much) it helped in engaging with them. These are discussed in the next section.

9.2 Synthesis of findings

The findings of the research, derived from the three studies, are synthesised in this section, in relation to the three research questions and their sub-questions.

Research Question 1: (How) can visitor-constructed trails support meaning making in museums?

Defining visitor meaning making

This research question addresses visitor meaning making. The theoretical framework discussed in Chapter 4, and the TrACE conceptual model derived from it, and developed throughout the studies, locates meaning making epistemologically in the bridging of personal and social contexts of visitors and artefacts, as well as the physical contexts of individual artefacts, and the museum as a whole. As described in Chapter 1, this thesis did not intend to measure learning quantitatively, rather looked at the process of trail construction, and qualitative aspects of visitor encounters with artefacts through the activity of trail construction. Meaning making is therefore defined as taking place at the site of encounter between visitor and artefact, in interpretative processes of internalisation and externalisation and which can be detected and analysed in language and dialogue, including questions, descriptions, explanations, predictions and reflections.

Trails were shown to support museum meaning making, thusly defined, by acting as a structure with which visitors could constrain their visit; and by prompting the articulation of personal and negotiated interpretations in the form of monologues and dialogues containing descriptions, explanations, predictions and reflections. Across the three studies in this thesis, trail construction was increasingly structured, more and more narrowly defined, and more explicitly identified as a primary goal, in order

to focus visitor activity on a product useful for meaning making. Since each study took place with a different topic and visitor and museum type, it is not valid to compare the studies in terms of the quantity or quality of learning outcomes. However, it can be concluded that overall, the process of trail construction was better understood, and the end product more coherent, when the activity of constructing a trail was clearly identified to all stakeholders as a primary goal of the activity, with the product being a coherent, possibly narrative, trail.

Specifically, in the first study, meaning making could be located in visitors' open- and closed-ended questions linking to their personal and cultural contexts; and in dialogues involving descriptions, explanations, predictions and reflection which were prompted by museum artefacts — thereby conforming to constructivist epistemology as defined in Chapter 4. In the second study, all these types of interpretive language were evident in visitors' trails, again as both monologues and dialogues. In that case, the visitors recorded photos and text in addition to audio, and visitor-captured photos were seen as a form of personalisation. In the third study, questions, descriptions, explanations and reflection were all located in a fictional narrative which constituted the visitors' audio trail. Meaning making could additionally be detected during the course of trail construction, in the negotiation and discussion of interpretations which took place in front of artefacts and in reflection afterwards. The structure of the trail enabled the visitors to link together individual and negotiated meanings made from individual artefacts, in a coherent, narrative structure — thereby validating trails as a structure to support meaning making.

Support for navigational learning

In the first study, adult visitors to art museums interpreted the trails concept differently — some creating discrete trails stops in relation to individual artefacts, and others recording the entire process of navigating the museum. Nonetheless, the study shed light on some of the ways visitors interpret artefacts by making links to their personal and social contexts; the trails concept, closely linked to the recording technology, prompted the participants to externalise their interpretations. In addition, one trail which was constructed as a continuous monologue and dialogue served as a kind of narrative of a visit, highlighting particular aspects of the physical context such as the museum architecture as an artefact itself; and the role of other visitors as objects of study, or conversely as an obstruction to artefacts of interest. Navigation was thus defined as the intersection of the physical context with visitor activity, and it was located, conceptually, close to the site of meaning making. This lends

support to Peterson and Levene's (2003) notion of 'navigational learning' which underlies the trails concept.

Internalisation of trails / externalisation of interpretations

A relevant avenue of inquiry regarding trails, identified in Chapter 3, was the extent to which trail construction can or should be internalised by a visitor as a form of self-regulation. Evidence from the first study supported this, in the continuous recorded trail in which Rachel forgot she was recording. In that study, as well as in the final study, the recording device was seen to effectively embody the trails concept to the participants. In these cases the narrow definition of the activity was linked with what was, effectively, a single-purpose device. In the second study however, the device was associated with scientific data collection as well as trail construction, and this caused conceptual conflicts.

In all three studies however, the device effectively prompted the externalisation of visitors' interpretations, as well as navigational decisions in the first study, and scientific observations in the second. In the third study, the device was so strongly linked to the goal and product — the construction of an audio trail — that it is difficult to disentangle it as the sole source of externalisation. That the devices had such a central role in prompting visitors to articulate their interpretations suggests that technology can serve to undo some of the ritualistic aspects of museum visiting identified in Chapter 2, such as the silent contemplation of artefacts, when they are incorporated into a structured activity such as trail construction.

The importance of goal and product

The second study was situated in an existing primary school science activity. This provided a topic to frame students' trails, as well as specific instructions, such as to record observations and evidence; the technology dictated that these took the form of image, audio or text. The use of a guiding topic in trail construction resulted in some clear and coherent links between individual trail stops, and within the trail structure students were creative, for example interviewing each other, and capturing a wide variety of photographic evidence. They overcame limitations in the technology — for example the inability to upload image and audio simultaneously — by utilising the linear trail structure to

construct trails consisting of, for example, an image containing evidence followed by an audio clip containing an explanation.

However, while most students understood the concept generally, trail construction was not clearly defined as a primary goal of the day's activity; rather, it was conflated with the pre-existing goals of scientific observation and collecting evidence. As a result, while the trails effectively linked individual artefacts in a social context relating to plant taxonomy, they lacked a coherent narrative structure to tie them together, and the trails are not coherent as standalone products. Therefore, trail construction should be a primary goal, with attention paid to the final product, how it will be used, and by whom.

In the final study, involving teenagers at a small history museum, the goal was explicit to all participants, clearly defined as the construction of a trail which would help other young people to navigate the museum and encounter artefacts. Once students understood the sub-concepts of trail stops and linearity, the trails concept effectively structured their activity. The students engaged with the process, reconciling trail construction with their goal of performing a drama. Their encounters with artefacts, and with the galleries and museum generally, were shaped by contextual factors, and made personally and socially relevant through their activity and dialogue, into a coherent product.

The centrality of narrative

Narrative was a central aspect of the final study, but also played a role in the first study, in terms of describing a museum visit. As discussed in Chapter 4, such narratives were identified as one the outcomes or products of casual museum visits, for example in the stories told to friends and family about museum visits. Set within the broader cultural context, these narratives relate to rituals of socialisation, and initiation into particular specialist communities, as described by McClellan (2003b).

In the first study, narrative threads were also identified with regard to individual artefacts, artists, or personal experiences triggered by artefacts. Similarly in the second study, narratives relating to personal and cultural experiences were mentioned by students with regard to individual plants or categories of plants. These were often linked with leisure activities — for example a Harry Potter story, or a football match — and in Chapter 2, the role of museums as places of leisure as well as learning was discussed. Therefore, in retrospect, narrative could have served to strengthen the links in trails in the first and second studies through its role in learning as well as entertainment, by helping to

bridge visitors' personal experiences and artefacts' contexts, both of which contain strong elements of narrative. Other specific strategies utilised in trail construction, including re-contextualisation, the interrogation of multiple perspectives, interviewing other visitors, looking closely and describing artefacts, explaining uses, making predictions, and reflecting on past experiences, could all be linked with narrative, with trails providing a structure for holding a narrative together.

In summary, trails can support museum meaning making among different visitor groups and in different museum types, by providing a curatorial scaffolding for visitors' re-contextualisation of artefacts, when they have a clear goal and product, and a limited scope, through the articulation of interpretations arising from navigation to artefacts — interpretations which are links between visitors' and artefacts' contexts, and are generally narrative in form.

Research Question 2: How do portable digital technologies mediate and support trail construction?

Technology mediates bi-directional contextualisation

In the theoretical framework developed in Chapter 4, portable digital technologies are viewed from the perspective of activity theory as mediating tools which could help visitors engage attentively, cognitively and emotionally with museum artefacts through the appropriation of artefacts' narratives. This can be accomplished specifically through 'downwards contextualisation' — for example, coming to an understanding of how an artefact was used; or 'upwards contextualisation' — for example connecting an artefact with the visitor's interests or goals. In the studies conducted in this thesis, both of these types of contextualisation were observed; in the TrACE model, downwards contextualisation was oriented in the direction of artefacts' contexts, and upwards contextualisation with visitors'. Furthermore, the model showed that these processes of contextualisation need not be mutually exclusive: for example, in the second study, engaging with food plants often meant comprehending how they grow 'in the wild,' how they are utilised by humans as food and as objects of scientific study, as well as linking them to visitors' own personal or cultural experiences. Mediating technologies acted as the means to capture aspects of plants' contexts (for example using photographs), and to articulate visitors' contexts (for example in audio recordings).

The role of technology in multiple mediation

In this thesis, the 'double mediation' of meaning making through both tools and artefacts (Kaptelinin, 2008; Pierroux et al, 2007) was investigated for the first time in an empirical study. In the second study for example, individual plants as well as the mobile phones mediated study of the topic of each trail — a topic which equated with the plants' shared social context, as defined in the goals of the activity. Furthermore, the study of a particular topic was observed to be mediated not only by artefacts and digital technologies, but also by other visitor-carried tools such as paper worksheets, by fixed tools such as interpretive labels, and by human resources such as museum educators. Thus, 'multiple mediation' is a more accurate term for some meaning making in museums.

This multiple mediation was not always linear or hierarchical, with for example instructions on paper dictating how a digital technology was used. Visitors switched between tools and resources as needed: for example writing a script then reading it into a recorder, or conversely, recording a rehearsal then revising a written script. In the third study, students recorded what museum educators told them on the devices, but also recorded their own rehearsed narratives to play back to educators. Therefore, digital technologies need not be viewed as a replacement for either paper tools or human resources; rather, they can work best when viewed as part of what Luckin (2008) terms an 'ecology of resources.'

Personalisation through interpretation

The construction of individual trail stops involved a transference of information from one medium to another, or from the physical context to the personal; when personal interpretations are added, this was seen to constitute personalisation of the trail. Furthermore, in the third study, students' encounters with artefacts were not only shaped by their own personal contexts, but shaped *into* personalised characters in a process of personal and social construction, and this was regarded by museum educators as 'personalising' the trail. While the students surrendered their own personal interpretations of artefacts, the characters were undoubtedly influenced by students' individual and shared personal experiences. Thus, while technology-focused research on trails (e.g., Papadogkonas, Roussos and Levene, 2008) regards technological personalisation as an adaptive delivery of information to visitors based on visited locations, personalisation of a trail can alternately be seen as visitor-constructed interpretation through the device, involving links to the visitor's personal context,

or through a visitor-constructed narrative; both of these constitute what could be termed 'personalised curation.'

Technology frames, and is framed by, activity and context

The way that devices were used depended on how they were framed in terms of the goals and social context of the activity. For example, the first and third studies both used audio recorders, but in the first, the devices were used differently, depending on participants' interpretation of the goal, and on whether they constructed a trail alone or with someone else. In the third study, a narrow goal definition led to a narrow use of the devices, and the devices additionally were closely linked not only with trail construction, but also were intended to be used by other visitors to follow the trail; this helped the students conceptualise the trail in terms of portability and linearity of trail stops. In the second study, the mobile phone-based system was flexible enough to be used for capturing scientific evidence as well as for trail construction, using a variety of media; but the activity was not narrowly defined around trail construction.

Conversely, the activity of trail construction was affected by technological limitations. In the second study for example, audio recording was limited to 15-second clips. Yet this served to focus students on using descriptive and specialised language precisely, in order to make concise recordings which they thought would be used in assessment. The mobile phone-based system allowed for editing of the trail and the captured data, but this had to be done on a web site, not the device, and teachers and students did not make use of this facility. In the first study, participants did not do any editing, because the end use of the trail was not explicated. In contrast, in the final study, this use was made clear, and participants edited the trail by making successive recordings as rehearsals, then recording a final single clip for each stop. Thus in the final study, the trail was edited and finalised while in the museum, using the devices, with support from paper-based tools. This implies that trails generally need editing to be shaped into a usable form, and this is best done while in the museum.

This suggests a two-way relation between theory and practice: just as the use of a technological tool is influenced by how it is framed within the context of an activity (as audio recorders were implicitly linked to trail construction), the activity of trail construction is influenced by the capabilities of a technology (as My Art Space conceptualises trails as a series of visitor-constructed objects). This also lends evidence to Gammon and Burch's (2008) finding that the design of museum technologies should relate to visitors' mental models of technology, as discussed in Chapter 2.

In summary, technology can help bridge the contexts of visitors and artefacts through a two-way contextualisation, which also may be mediated with, or through, other tools and resources; specifically, technology mediates the bridging of contexts by embodying the trails concept on the one hand, and by prompting articulation of personalised interpretations on the other, when it is situated in well-defined trail construction activities which are suited to the technology used.

Research Question 3: What is an appropriate model for the design and analysis of technology-mediated museum trails?

A model is a representation of the essential structure of some object or event in the real world. The TrACE model developed in this thesis, shown in Figure 9.1, is based on a rich definition of the museum context, situating meaning making in the bridging of personal and social contexts of visitors and artefacts, mediated by tools and resources, and set within the physical contexts of artefacts and the museum as a whole.

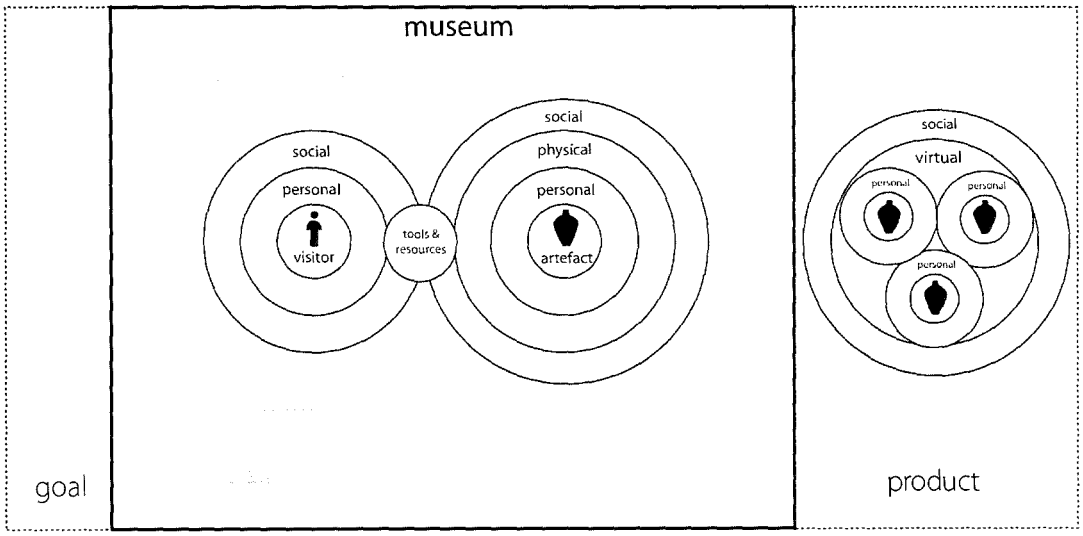


Figure 9.1 Final TrACE conceptual model, as refined in the three studies in this thesis.

This model built on the approach to framing learning and technology in museums by Pierroux, et al (2007) which was grounded in activity theory, and focused on visitors' and artefacts' activity contexts, with meaning making seen as the bridging of those contexts, mediated by tools. This was developed

into a conceptual model by Kaptelinin (2008), which detailed the 'double mediation' involving both technological tools and museum artefacts mediating a subject's study of a particular object. This model was specific to the domain of history however. It also neglected surrounding artefacts in the museum, as well as other aspects of the physical museum context which are vital for museum meaning making generally and trail construction specifically.

The TrACE model developed in this thesis was therefore intended to depict the rich context of artefact-centred learning in museums, drawing from the Contextual Model of Falk and Dierking (2000) to embed context in an activity-centred model, and developing the notion of activity contexts of both visitors and artefacts, for example by enriching the contexts of artefacts by dividing them into personal, social and physical contexts.

Meaning-making was located in mediated encounters between visitor and artefact, specifically in links between the personal contexts of both, for example through the articulation of personalised interpretations of artefacts' attributes and uses, using a portable digital device. The visitor's personal context was shown to include broader cultural influences, whereas the visitor's social context was restricted to the local social conditions of the activity. An artefact's personal context was defined as the individual history of its creation, use, collection, preservation and display; its social context is its relation to its original culture in which it was created and used; this generally related it to other artefacts. Artefacts are regarded as having their own physical contexts which visitors move through, for example being located in particular galleries, with the overall museum environment positioned as a space surrounding the overall activity space of a visit.

Trail construction was defined as the re-contextualisation of individual artefacts in a shared social context, a process equivalent to the practice of curators; in trail construction, however, artefact interpretations are transferred from the physical context to a virtual context through technological means — specifically portable digital technologies which can be used at the site of encounter between visitor and artefact. A goal and product linked activity theory with a constructionist epistemology, and served as 'bookends' around the museum-centred activity.

The TrACE model helped in both the design and analysis of trail construction activities. For example, in the second study the roles of scientist and journalist were socially negotiated, personally enacted and technologically mediated, oriented toward interrogating artefacts' personal contexts as a means of illuminating their social contexts. This influenced the design of the trail construction activity in the third study, and subsequently, the descriptions, explanations, comparisons and reflections formerly

observed in a science context could also be seen in the construction of a fictionalised, historical narrative; in both cases this was at the intersection of the personal and social contexts of visitors.

The following list of indicators for analysis was derived from the TrACE model.

1. Goals
    - Goals and outcomes;
    - Sub-goals, aims and objectives, and relevant actions and operations;
    - Means and ends, and general structure of the activity.

2. Contexts
    - Activity develops through the interaction between visitor, artefact contexts.
    - Personal context: Links visitor's attitudes, experience, preferences, and artefacts' personal, social contexts; visitors investigate artefacts' personal attributes as a means of investigating artefacts' social context.
    - Social context: Social conditions of visitors' activity including roles and division of labour; and visitors' language including description, reflection, explanations, comparisons, questions.
    - Physical context: Fixed and shifting environmental features and conditions, in relation to artefacts and contexts .

3. Tools & resources
    - Resources available in artefacts' physical contexts;
    - Visitor tools including modes of communication, relation to and links between museum tools;
    - Social resources and other stakeholders; and
    - Use of tools and resources over the course of the activity in terms of mediation, breakdowns and their resolution.

4. Product
    - Products created by visitors in relation to goals, contexts, intended and unintended uses.

The final study illustrates how these indicators can be used for analysis. First, in designing the activity, the goals and outcomes were made explicit to all participants, around the collaborative construction of an audio trail, with the product — the completed trail — an implicit part of the goal.

Moving up the object hierarchy to analyse participants' motives showed that the visitors had some intrinsic motivation to participate, but their participation was also influenced by their peer group. The museum educators were motivated by their desire for an audio tour to engage young people with the museum when educators were not available. Both sets of participants also had to work within the needs of the funding programme in which the activity took place. Moving down the object hierarchy to sub-goals, it was agreed to limit the trail to around six stops, to have a strong narrative theme, and to integrate artefacts and physical settings into the trail.

Analysing the development of the activity involved focusing on how visitors and educators negotiated completion of the goal — specifically, the educators engaged the visitors in a role-playing activity and proposed integrating drama in the trail. The visitors then developed the characters and story from direct encounters with museum artefacts and settings, through discussion, negotiation, and navigation.

Looking more closely at visitors' and artefacts' contexts provided a deeper level of analysis. For example, the construction of fictional characters enabled the visitors to 'personalise' the trail; in so doing, they implicitly drew upon their own personal experience but forfeited their own explicit interpretations of artefacts. Characters' monologues and dialogues bridged the visitors' personal and social contexts, and the trail linked these in turn with the social contexts of artefacts by merging museum interpretations with fictional narratives. The narrative trail acted as a shared social context, linking artefacts which were not otherwise obviously linked, and more broadly linking every part of the TrACE model. The horizontal division of labour was described as each visitor developing a single character, with group negotiation of the storyline; the vertical power relations were such that the visitors were ostensibly in a position of power as creators, but their activity was guided by the educators.

The trail was comprised of, and negotiated in, language. As in the second study, an agreed time limit to recordings prompted the visitors to be both expressive and concise. They explored issues of social class through speech, and abandoned the idea of contemporising the museum in favour of 'getting into character,' adopting and adapting historical language. As in the second study, questions and explanations were identified (here in character dialogues), as well as descriptions, comparisons and reflection (here in character monologues). The personal contexts of artefacts were referenced as a means to explore their broader historical significance (social contexts), and the artefacts were additionally 'personalised' by attaching fictionalised stories to them — effectively bridging the personal contexts of artefacts with the personal contexts of the fictional characters.

Regarding the physical contexts of artefacts, the visitors approached each room of the museum as curators, working on and recording each trail stop in the room for which it was intended, directing attention to particular artefacts, and considering how listeners would navigate the museum as a whole. The explicit goal of making an audio trail for others to follow — in a physical as well as narrative sense — thereby effectively linked the trail directly to the physical contexts of the artefacts. These physical contexts were distinguished in the TrACE model from the overall physical context of the museum generally, which in this study was synonymous with the overall narrative structure of the trail.

In focusing on mediating tools and resources, the importance of audio was validated in this study. Working with audio recording over five days helped the visitors become comfortable with the technology, and with hearing their own voices. The narrow interpretation of the recorders as tools was related to the narrow definition of the goal. The visitors also used paper and pen to take notes, write scripts which were read into the recorder, and to create mind maps which helped structure the trail. A printed guidebook used in the activity was situated in the TrACE model, along with the museum educators, as a mediating resource which worked in concert with an ecology of other tools and resources.

Finally, the completed trail was analysed against its relation to the initial goals. An initial conflict between creating a drama and the need for an audio trail was reconciled by agreeing to incorporate the drama into the trail. The resulting product balanced the nonlinearity afforded by the technology with the linearity of the storyline, with narrative tying each stop together. Navigational directions and sound effects rounded out the usefulness and expressiveness of the trail, and the participants as well as the funders all agreed that the product met the stated goals.

In summary, a conceptual model was iteratively developed for the design and analysis of technology-mediated trails in museums, with rich descriptions of visitors' and artefacts' contexts, and goal-oriented activity leading to a concrete product, mediated by technological tools and other resources. This merges a rich model of context with an activity-centred model of active visitor construction.

9.3 Contributions of this thesis

This thesis's main contributions are to the fields of museum education and educational technology, as detailed below.

9.3.1 Contributions to museum education

This thesis utilised a precise definition of meaning making in collections-based museums as the bridging of visitors' and artefacts' personal contexts. The result was that, broadly speaking, in the design of technology-mediated activities in museums, the focus should be on the activity, not the technology. In each of the studies, readily available technologies were utilised and the design process focused on structuring the activity around technology use. Therefore, novel technologies should not be implemented without adequate attention paid to the concepts of activity, context and mediation.

One specific contribution to museum education is the validation of technology-mediated trails as an activity for visitor meaning making from artefacts. Trails were investigated in art, science and history museums, with adults, primary students and teenagers, and some value was demonstrated in all of these cases; overall, trails were found to be effective for structuring visitor meaning making when they had a clear goal, limited scope, and well-defined product, and were conducted entirely in the museum, without the need for post-visit editing.

Another contribution is to add to the growing body of research on museums and technology grounded either in Falk and Dierking's (2003) Contexual Model, or in activity theory. This thesis specifically developed further the notion of activity contexts of visitors and artefacts, and the mediation (and multiple mediation) thereof. The mediated bridging of activity contexts had not been investigated in an empirical study. Thus, this was the first investigation using a version of the model, albeit in altered form, with positive results in terms of both analysis and design.

The literature review revealed that while museums accept the basic tenets of constructivism, they generally do not regard constructionism as defined by Papert (1987, 1980). This thesis defined trails as visitor-constructed products, instead of emerging automatically from visitor's unguided navigation, as defined by Peterson and Levene (2003), and investigated the end product of trail construction in relation to the goals of the activity. Technological tools not only mediated visitors' meaning making,

but were used explicitly for construction of the trail. This thesis therefore contributes to a very small body of museum-related research grounded in constructionist epistemology.

9.3.2 Contributions to educational technology

There has been some technical development with regard to trails, as noted in the Chapter 3. But this thesis was the first to study trails with in a pedagogically grounded way, not aimed at technological development but at understanding how trails can help people to structure their meaning making in physical environments such as museums. Thus it contributes pedagogically to the literature on trails. Specifically, the TrACE conceptual model developed in this thesis defines trails in terms of the re-contextualisation of artefacts, and the model provides a means of designing and analysing trail-based activities.

More broadly informing technology design, this thesis proposes focusing on the design and analysis of mediated, contextualised activities, not on technologies themselves, in technological interventions aimed at meaning making. Thus, the findings reported here may also be useful to the interaction design community.

9.3.3 Methodological contributions

The methodology utilised in this thesis did not involve the design of a new software or hardware system, but utilised readily available technologies in the design of trail-based activities. Two existing analytical tools were used in the first study, then as the TrACE model was developed, a series of indicators was derived for use in the design and analysis of technology-mediated activities.

From the first study, technology served a dual purpose methodologically. It was used by participants for trail construction, as well as for gathering qualitative and quantitative data for analysis. Analytical tools in the first study helped to uncover important aspects of context; for example, the acts of gathering around, participating, and negotiating meanings were seen as effectively equivalent with regard to museum artefacts, since the activity undertaken was interpretation through dialogue. The TrACE model was further developed in successive studies, resulting in a model with specific indicators which can inform the design and analysis of trail-based activities.

9.4 Limitations of this thesis

9.4.1 Practical Limitations

In order to constrain the scope of investigation to meaning making in museums, this thesis focused only on activity that took place in museums. It did not therefore look at what participants did before or after the visit — aspects which are recognised (e.g., by Falk and Dierking, 2000) as important for long-term meaning making. In the first study for example, guidance was deliberately not given to the participants before their visit, in order to investigate how each would interpret the trails concept while in the museum; afterward, the participants were not interviewed and no attempt was made to engage them in revisiting, editing, or otherwise re-using the trails they constructed. In the second study, schools began work on the plant-related module before they visited the museum, and were presumed to work on it afterward. In that case, students and teachers were interviewed afterward, but only in order to investigate and reflect on the activity they undertook while at the museum; other research (Johnson, 2007) has studied the longer-term aspects of the students' learning about food plants, but not in relation to trails. In the final study, the entire activity took place in the museum, including interviews with the participants before and afterward. Interviews would have been useful after all the studies, focusing specifically on participants' reflections on their trails, the construction process, and their perceived usefulness.

While the proprietary My Art Space system was utilised in the second study, no technological development took place during this thesis; instead, it focused on the iterative design and analysis of activities using readily available technologies. The other studies used off-the-shelf digital audio recorder/players.

Methodologically, it would have been useful to record all three studies using video. As discussed in Chapter 5, video has been used for recording visitors undertaking activities, particularly in studies grounded in activity theory. In the second study, it was useful for capturing students and adults negotiating the use of the mobile phones, interacting as groups, and discussing the activity. Video recording was not used in the first study in order to maintain 'normal' adult visits to the extent possible, and in order to investigate audio recorders as a sole means of data capture as well as trail construction. In the collaborative trail in that study, the dialogue between participants added some of the richness of context that video would have captured, and this richness was missing in the two solo trails. In the final study, the participants asked not to be video recorded, and in that case also, longer

recordings helped to illuminate their discussions and negotiations during the trail construction process.

While this thesis investigated the trails concept across different museum and visitor types, with the aim to generalise the findings, it is recognised that there are other museum and visitor types which were not included for practical reasons. For example, university students are an underserved visitor group, according to Reynolds (2007), and trails created for university-level students in design by tutors have been evaluated in other research (Walker, 2008). While art, science and history are the most common museum types, the museums included in the studies in this thesis do not necessarily represent all other museums, since one of the virtues of museums is that each one is unique. Thus while the research findings can be generalised broadly, specific implementations of trails would inevitably require tailoring them to the unique qualities of each museum and visitor group.

Methodologically, audio recorders were intended to prompt visitors to externalise their interpretations of artefacts. This was successful, but audio recordings do not necessarily externalise all the internal representations that visitors may have constructed. Mind maps, used by participants in the final study, or concept maps, discussed in Chapter 2, are intended to externalise these internal representations to a certain extent, and could be employed further.

9.4.2 Analytical Limitations

Museums are generally good places to conduct research in both meaning making and technology, since as 'semi-formal' institutions they are broadly aimed at education, but are reconfigurable with regard to space as well as educational content. Yet museums are challenging for the researcher: physically, because a wide range of visitors moves about in an uncontrolled manner, as evident in the first study; and pedagogically, because as discussed in Chapter 2, museum meaning making is complex, personal, and can stretch beyond the few hours of a typical visit. Schemes intended to identify measureable 'learning outcomes' have thus tended to be very broad, such as the 'Generic Learning Outcomes,' or very narrow, such as simple exit surveys, both of which were discussed in Chapter 5.

My approach was to formulate a specific definition of meaning making based around visitor encounters with individual artefacts, and to focus on the contexts and mediation of these encounters, during trail construction activity. This included the social and physical contexts, but centering on an

individual visitor contrasts, for example, with other approaches which regard communities or whole activity systems as primary units of analysis. My model was based on the central assumption, discussed in Chapter 2, that all museum meaning making is personal, hence individual.

As discussed, the interpretation of activity theory used in this thesis was from Leont'ev (1978) by way of Kaptelinin and Nardi (2006), not that of Engeström (1987). One analytical tool thus used in the first study was the Activity Checklist of Kaptelinin and Nardi, and my resulting analytical tool, after three iterative studies, was in the form of a list of indicators. This could be considered too linear and prescriptive, but it is intended to work in concert with the TrACE model from which it was derived.

Regarding trails, I did not utilise the taxonomy of trails developed by Schoonenboom, et al (2007) to categorise trails, since as discussed in Chapter 3, the taxonomy was developed primarily to inform the development of adaptive technologies, whereas my approach was pedagogical. Similarly, I only focused on what the authors term the 'enactment' of trails, not editing or other steps; I also re-framed trails as a visitor construction, not an automatic construction based on comparatively passive visitor navigation. Thus while this thesis is grounded in the trails concept as defined by Peterson and Levene (2003), it departs from the technical research trajectory undertaken by others, in favour of a pedagogical one.

This thesis adopted a constructionist epistemology as defined by Papert (1987) around the concept of learners building 'things to think with,' which complements the widely held view of constructivism — that learners actively construct meanings internally (and socially, in the case of social constructivism). Research grounded in constructionism, as described in Chapter 5, is often oriented toward design processes and the design of computational artefacts (e.g., Cobb et al, 2003; Di Sessa, 2000). As discussed above, this thesis did not engage in technical development. It did, however, analyse visitor-constructed trails as part of an iterative design process, though in this case aimed at the design of activities, not technologies. This was closer to Ackerman's (2002) interpretation of constructionism which places narrative at the centre, with digital technologies employed to help learners re-contextualise narratives.

9.5 Further research

The development of visitor-constructed trails would benefit from further research in museums. Specifically, the TrACE conceptual model has been developed in this thesis, and could be validated

independently. Controlled studies could investigate different types of trails, or methods of construction, by particular visitor groups in a given museum. From museums' perspective, a large and diverse collection would benefit from technology-mediated activities which engage in visitors making narrative trails through a collection. Curators have their own narratives with regard to their collections, and a fruitful undertaking would be to further investigate the balance of curatorial versus visitor-constructed narratives in visitors' trails, by working closely with curators.

Approaches grounded in social constructivism arising from museums themselves, such as that of 'interpretive communities' (Fritsch, 2007), could benefit from the study of the construction, editing, sharing and re-use of trails in particular specialist communities. A specific opportunity exists at the Foundling Museum, where the audio devices containing the trails constructed as part of this thesis can be used by visitors not just to listen to the trail, but to record their own trails as well.

The perceived democratisation of curatorial knowledge, as discussed in Chapter 2, is closely linked to technological developments. Thus, post-trail editing and sharing could be investigated in online environments such as museum web sites or online social networks. Research on trails has been conducted in online environments (e.g., Borges and Levene, 2007), and linking these with physical environments could open many possibilities — not just for museums but for informal learning in many places. Similarly, an open question is whether visitor-constructed trails might be useful in other places such as urban areas or cultural heritage sites. Trails could also be applied to particular specialist communities, such as scientists engaged in fieldwork.

There is thus potential to merge the pedagogically-grounded research in trails, as in this thesis, with the technical development, undertaken by Roussos, Levene and others, for developing systems to support not just adaptive navigation but re-contextualisation and narrative construction in museums and other places. For example, the use of mind maps in the final study in this thesis could inform the development of an interface for trail construction on a portable digital device; Byrne, et al (2008) utilised concept maps as a kind of script for narrative construction using a portable multimedia system, but not related to trails. Trail representation generally requires further work, particularly focused on end users.

9.6 Implications for museums

Museums were described in Chapter 2 as simultaneously authentic and artificial cultural constructions, situated in between formal and informal learning institutions. They generally contain collections of ancient artefacts, and often utilise the latest digital technologies for interpretation thereof. But such technologies have brought with them a discourse of democratisation, threatening curatorial authority — for better or worse. Yet despite the technical ease of soliciting visitor interpretations, visitor motivation remains a clear challenge for museums, except where there are specific, engaged communities or targeted activities. This thesis investigated visitor-constructed trails as one such activity, and found some value in them as a structure for balancing curatorial and visitor narratives in relation to artefacts. Moreover, this value was demonstrated with simple, common technologies which visitors already carry, including digital audio player/recorders and mobile phones. A key to visitor engagement thus may lie not in technology itself, but in the design of activities around it.

Another open issue is whether, and if so to what extent, digital devices distract from the authentic artefacts collected and displayed by museums. As discussed in Chapter 2, introducing technology to an already rich sensory environment threatens to overwhelm visitors who may already be physical and cognitively overwhelmed. More than 10 years ago, Mintz proposed that technology could alternatively help visitors experience museum exhibits more like an expert (Mintz 1998: 27), and that used well, technology can control the amount of information or expand visitors' options (Ibid., 32). Evidence from this thesis shows that structured activities such as trails could help to constrain visitors' meaning making within a manageable scope.

9.7 Implications for theory

As a first empirical investigation of the 'double mediation' of tools and artefacts, first proposed by Pierroux, et al (2007), this thesis found that 'multiple mediation' better describes this process, since multiple tools and resources might be utilised in visitor meaning making with regard to museum artefacts, whether the mediators are used simultaneously (e.g., taking a photo of an interpretive label about an artefact, for the purpose of investigating its social context), or alternately (e.g., switching between digital and paper-based tools in constructing an interpretation). Evidence was provided that digital technologies can help bridge visitors' and artefacts' contexts.

This thesis acts as a bridge itself, between Falk and Dierking's (2000) Contextual Model, which has been a dominant research paradigm in the US for studying museum meaning making; and activity theory, which has grown in influence in European research into both technology and museums. Additionally, this thesis made links between these approaches and constructionism, with its more design- and practice-oriented approach to research.

9.8 Implications for technology design

In terms of technical development, the main implication from this thesis is to focus on the design of activities, not technologies. This goes beyond the study of technologies-in-use, as has previously been done in activity theory. The goal-oriented activity of trail construction was embodied in simple, visitor-carried technologies, which were used, in turn, to construct narrative-oriented products. The use of existing technologies brings flexibility, but also usability challenges, even when technology use is situated in a clearly-defined activity. Thus, scope exists for design — perhaps of software for portable digital devices — which aids in personalised and collaborative recording, reflection, editing, constructing and sharing of narrative-oriented products such as trails.

Specifically, according to Kaptelinin (2008):

> ...the distinction between upwards and downwards contextualization can be usefully employed in design of digital technologies. First, it can help designers decide whether they should make visitor's tasks more challenging or the chief objective should be ensuring the ease of use. In case of downwards contextualization it is often sensible to employ technologies for making learning effortless. However, in case of upwards contextualization technologies can enhance engagement via creating a challenge for visitors. (Kaptelinin, 2008:11)

Evidence from this thesis shows that these options need not be mutually exclusive. From the standpoint of constructionism, challenging the visitor (for example in constructing a narrative trail) can be embedded in the design of the activity, whereas ease of use can be the focus of technological development.

9.9 Conclusion

This thesis explored how people make meanings in and from museums, as mediated by digital technologies, through visitor-constructed trails through museums, with attention to the design and structure of activities, the role of context(s), and technological mediation. Trails were explored as a visitor-constructed product, a means of bridging the personal and social contexts of visitors and artefacts, through a balance of curatorial and visitor-generated interpretation, using simple, common technologies such as mobile phones and digital audio player/recorders, in structured and goal-oriented activities. A conceptual model was developed for the design and analysis of technology-mediated trails in museums, with rich descriptions of visitors' and artefacts' contexts, and goal-oriented construction activity leading to a concrete product, mediated by technological tools and other resources.

Trails were shown to support museum meaning making in different visitor and museum types, by providing a structure for personalised curation and re-contextualisation of artefacts, when they have a clear goal and product, and a limited scope, through the articulation of interpretations arising from navigation to artefacts — interpretations which are links between visitors' and artefacts' contexts, and are generally narrative in form. Technology can help bridge the contexts of visitors and artefacts through a two-way contextualisation, which also may be mediated with, or through, other tools and resources.

Contributions to museum education and educational technology were described, the limitations detailed, and areas of further research identified. Implications for museums were identified in the design of activities around technologies aimed at constraining, not adding to, visitors' cognitive load. In terms of theory, this thesis has implications for the study of mediation, and in the links between different broad areas of research such as activity theory, mobile learning, visitor studies and constructionism. For the design of technology, the findings imply focusing on clearly-defined activities involving bi-directional contextualisation.

The future of meaning making with technology in museums, in summary, may not be in new technologies themselves, but in the design of activities which situate them in context(s), and employ them to help visitors re-contexutalise museum artefacts, in personalised meaning making.

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Appendix 1

Family Learning Assessment Tool (Falk and Dierking, 2003)

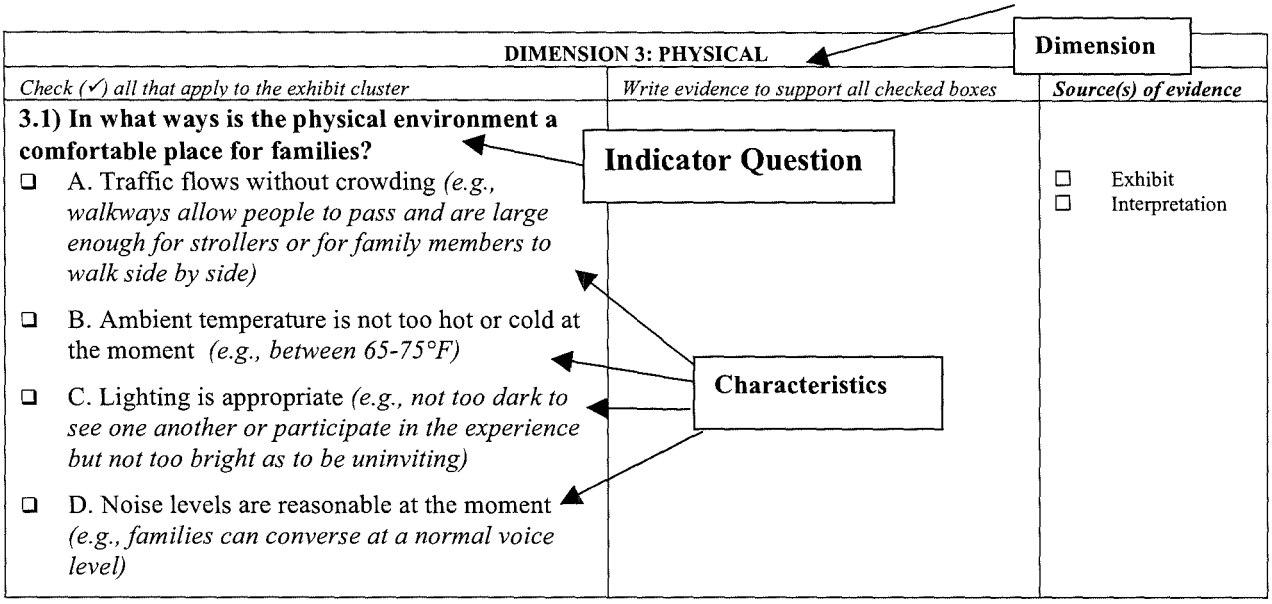
OVERVIEW OF THE ANNUAL FAMILY LEARNING ASSESSMENT TOOL

The Annual Assessment is designed to allow an efficient and "quick" examination of the essential components of family learning experiences in exhibition galleries. It is not designed to be a comprehensive evaluation of family learning in these galleries but instead, is designed to document family learning in a series of "clusters" of exhibit units in each gallery, what we are calling an 'exhibit cluster.' The individual data from the exhibit clusters can then be compiled and analyzed to document family learning in the exhibition gallery. Therefore, in order to use the assessment, each exhibition must be subdivided into exhibit clusters that reflect natural groupings of topic and visitor use.

The Annual Family Learning Assessment Tool consists of a three-dimensional framework organized around Dierking & Falk's Contextual Model of Learning: 1) Socio-Cultural, 2) Personal and Cultural, and 3) Physical. Dimension 1 uses an observation-based framework for assessing the social dimension of family learning interactions. Dimensions 2 and 3 consist of four or five indicator questions that include a checklist of characteristics. The data collector should check all of the characteristics that apply to an exhibit cluster. Each indicator question also requires the data collector to provide evidence to justify the characteristics that are checked off. Remember, that it is highly unlikely that a single exhibit unit would reflect all of the characteristics listed in the Annual Assessment. Appendix B contains the complete instrument.

What Does the Annual Assessment Look Like?

The Annual Assessment consists of the 3 dimensions described above. In each dimension are indicator questions, (e.g. 'In what ways does the experience appeal to the multiple generations within a family?') which is followed by a list of characteristics (e.g. universal relevance across time). The indicator questions and the characteristics are in the first column. The second column is left blank so that you can write evidence for every characteristic you check. The third column allows you to check off whether the evidence was present in the exhibit, the interpretation, or both.



What are the Three Dimensions?

There are three dimensions in the Annual Assessment. They reflect the Contextual Model of Learning, thus the three critical elements of the family learning experience.

1) Sociocultural: This dimension is designed to document observable family learning interactions and the ways in which the exhibit cluster encourages family collaboration and communication.
2) Personal and Cultural: This dimension is designed to document the extent to which the exhibit cluster accommodates the interests and abilities of individual members of a family as well as reinforces or shapes the many identities of family groups.
3) Physical: This dimension is designed to document the extent to which the exhibit cluster physically accommodates multiple family members and family interactions.

You may find that some characteristics in the different dimensions are similar. The overlap provides a confirmation of some complex characteristics that are difficult to assess. The overlap also allows us to assess (through analysis) whether certain larger, cross-dimensional elements of family learning are present (e.g. the extent to which family reflection is supported can be documented by combining the results from selected questions in all three dimensions).

BACKGROUND DATA

Date _____ Weekday / Weekend (*Circle one*) Initials of data collector _____

Interpretation in exhibition gallery present during observation? (*Check all that apply.*)

☐ None ☐ First Person ☐ Greeter ☐ Facilitator
☐ Craft ☐ Casual ☐ Exhibit Interpretation (3rd Person)
☐ Volunteer/ Intern Present ☐ Other_____

Crowd Level (*Circle One*) Very few visitors Moderate number of visitors Crowded

Time assessment begun: _____ am/pm

Observe one family at a time. Check off characteristics observed, specifically whether they were related to the human interpretation, the exhibit cluster, or both. The evidence should support your decision to check or not check the boxes, including:

1) Targeted adult's focus of attention – e.g., museum staff; family group members; museum visitors not in the family group; map or activity guide
2) Action – e.g., standing, looking; waiting; talking; inquiring
3) Family involved – e.g., Mom + son; Dad + daughter r+ son; Mom + Dad
4) Overheard conversation – e.g., "I want to go to Playscape."

Score the family interaction at the targeted exhibit cluster on a scale of 0 to 4 where 0 = no activity or presence of characteristics and 4 = maximal activity or characteristics present throughout. After observing three families, give one holistic score for the exhibit cluster.

Family 1 — Description of family members (Adult or Child; Male or Female; Apprx. Age):

Family 2 — Description of family members (Adult or Child; Male or Female; Apprx. Age):

Family 3 — Description of family members (Adult or Child; Male or Female; Apprx. Age):

DIMENSION 1: SOCIO-CULTURAL	
1.1) In what ways is the experience engaging and thought-provoking?	
1.1 A) Connections to other experiences *(e.g., "Look, it's just like..." or "Doesn't this remind you of...?")*	❑ Exhibit ❑ Interp.
1.1 B) Elements of unpredictability *(e.g., crawl-through tunnels, flip panels with surprising answers; or "Watch this, you'll never guess...")*	❑ Exhibit ❑ Interp.
1.1 C) Open-ended outcomes or different outcomes *(e.g., activity that allows you to construct insects adapted to different environments; or "Mine came out like this..." or "That's different from...")*	❑ Exhibit ❑ Interp.
1.1 D) Information relevant to current issues *(e.g., references to current El Niño weather patterns or a local endangered species; or "Well Channel 4 said it was even worse in that report we saw the other day.")*	❑ Exhibit ❑ Interp.
1.1 E) Engaging with objects, reproductions, or models in a way that challenges people to think about their functional or aesthetic use *(e.g., unusual perspectives, such as a pie safe's current use as a decorative object in contrast to its historical use as a food storage device)*	❑ Exhibit ❑ Interp.

1.2) In what ways do family members participate?	
1.2 A) The more experienced model participation for the less experienced *(e.g., child shows adult how to use touch screen; or, "Here, if you push this part first...")*	❑ Exhibit ❑ Interp.
1.2 B) Direction is provided to help family members draw out ideas or participation by others *(e.g., child reads label and repeats out loud to other child; or, "Try and find the easiest way to ...."; or Staff suggestion leads to family conversation.)*	❑ Exhibit ❑ Interp.
1.2 C) There is meaningful observation as well as participation *(e.g., family member can step back from action but still comment on activity; or, "Well I can see from here that you still need to pull harder to get it all the way to the top.")*	❑ Exhibit ❑ Interp.
1.2 D) There is hands-on activity using objects, reproductions, or models. *(e,g., manipulating objects; or, "Hey, feel this dinosaur tooth!")*	❑ Exhibit ❑ Interp.

1.3) In what ways does the family collaborate or solve problems together?	
1.3 A) Encourages or requires two or more people to physically work on the activity simultaneously *(e.g., building both sides of an arch at exactly the same time; "I need you to help me...")*	❑ Exhibit ❑ Interp.
1.3 B) Encourages or requires designing and assigning roles *(e.g., putting together a play, or role-playing in the grocery area of Bones; "OK, you shop and I'll ring these up.")*	❑ Exhibit ❑ Interp.
1.3 C) Encourages or requires a turn-taking, collaborative, problem-solving process *(e.g., encourages one person to try something first, and another person to then join in; "Now you try...")*	❑ Exhibit ❑ Interp.
1.3 D) Encourages or requires synthesizing or reflecting as a group *(e.g., family needs to come to a consensus on what happened; "so do you still think the weather made the dinosaurs become extinct, cause I'm now thinking that...")*	❑ Exhibit ❑ Interp.

1.4) In what ways do family members communicate?	
1.4.A) Share basic information or fun facts *(e.g., "She said that ants can carry up to 50 times their own weight!")*	❑ Exhibit ❑ Interp.
1.4.B) Compare something to themselves or other family members *(e.g., "That dinosaur is smaller than me!")*	❑ Exhibit ❑ Interp.
1.4.C) Talk about family history or identity *(e.g., "I'll never forget when the whole family gathered around the brand new TV watching man walk on the moon.")*	❑ Exhibit ❑ Interp.
1.4.D) Ask or answer close-ended (usually yes, no) questions, leading to identifications or descriptions *(e.g., "Is this the queen ant?" or "That suit is from the 1920s.")*	❑ Exhibit ❑ Interp.
1.4.E) Ask or answer open-ended questions that encourage explanations *(e.g., "Do you know why dinosaurs became extinct?" or "I think those bones are like that to help him run faster.")*	❑ Exhibit ❑ Interp.
1.4.F) Offer explanations *(e.g., 'It is because...' or 'The reason why is that...')*	❑ Exhibit ❑ Interp.
1.4 G) There is verbal and non-verbal communication *(e.g., gesture, writing, or drawing is used to provide feedback or share information)*	❑ Exhibit ❑ Interp.

Check (✓) all that apply to the exhibit cluster	*Write evidence to support your decision to check or not check*	*Source(s) of evidence*
DIMENSION 2: PERSONAL AND CULTURAL		
2.1) What modes of presentation are used? ❑ A. Text *(e.g., text-based labels, exhibition guide, banner)* ❑ B. Physical manipulation or sensation *(e.g., pedaling bicycle, digging for fossil clues, holding hissing cockroach)* ❑ C. Audio *(e.g., talking with museum staff, listening to lyrics, hearing the calls of lions)* ❑ D. Video *(e.g., short movie clips)* ❑ E. Software *(e.g., computer-based experiences)* ❑ F. Photographs, pictures, or symbols *(e.g., image-based exhibition guide, mural, map, image of dentist's office)* ❑ G. Objects or reproductions *(e.g., decorative arts object, reproduction mid-19th century garment)* ❑ H. Models *(e.g., globe, scale model of a neighborhood)* ❑ Human interpretation *(e.g. staff presenting 1st person script, greeter, or staff presenting unscripted information related to exhibit*		☐ Exhibit ☐ Interp.

cluster) ❑ J. Physical immersion *(e.g., exhibit is designed to make visitors feel like they are in another place)* ❑ K. Live animals (*e.g. fish on display permanently in a tank, or reptiles brought to the exhibit cluster temporarily by a facilitator.*)		

2.2) In what ways are family members with different abilities accommodated? ❑ A. Reading and listening opportunities include vocabulary at different levels *(e.g., uses 'meat-eater' at one point and 'carnivorous' at another)* ❑ B. Includes variety of tasks at different levels of difficulty *(e.g., larger and smaller building blocks are provided for varying motor skills)* ❑ C. Reading and listening opportunities include basic <u>and</u> in-depth information *(e.g., layered labels with one simple, main message and then more detailed information)* ❑ D. Objects, reproductions, or models are used to illustrate concepts or provide information *(e.g., a complex physical science phenomena is illustrated through an object-based demonstration)*		☐ Exhibit ☐ Interp.
2.3) In what ways does the experience appeal to the multiple generations within a family? ❑ A. Different periods of time (or objects from different periods of time) are contrasted *(e.g., Barbie dolls from 1950s and 2000s)* ❑ B. Exhibit theme is universal enough to appeal to different generations *(e.g., nature, travel, animals)* ❑ C. Has immediate relevance to current issues *(e.g., presentation about the effect global warming will have on this year's snowfall)*		☐ Exhibit ☐ Interp.

2.4) In what ways are diverse personal and cultural histories taken into account? ❑ A. Includes explanations about a culturally-		☐ Exhibit

specific issue or context *(e.g., 'American Sign Language is as grammatically complex as spoken English')* ❑ B. Includes connections to the local community *(e.g., 'The temperature at Hoosier Hill is 83F.')* ❑ C. Includes connections to a variety of geographical areas *(e.g., city life and rural life, or northern and southern hemisphere differences)* ❑ D. Presents males and females in positive, non-stereotypical roles *(e.g., images of male and female police ,or a male nurse*		☐ Interp.
DIMENSION 3: PHYSICAL		
3.1) At the moment, in what ways is the physical environment a comfortable place for families? ❑ A. Traffic flows without crowding *(e.g., walkways are large enough for strollers or for family members to walk side by side)* ❑ B. Ambient temperature is not too hot or cold *(e.g., temperature between 65-75°F)* ❑ C. Lighting is appropriate *(e.g., not too dark to participate in the experience but not too bright as to be uninviting)* ❑ D. Noise levels are reasonable *(e.g., families can converse at a normal voice level)*		☐ Exhibit ☐ Interp.
3.2) In what ways are multiple family members physically accommodated? ❑ A. Can multiple family members gather around? *(e.g., there is ample space around the activity so that family members can cluster around it together)* ❑ B. Can more than one family member actively participate? *(e.g., activity is designed to support multiple users; there is ample space for several sets of hands and bodies)* ❑ C. Can both children and adults comfortably access it? *(e.g., placement of activity components works for family members of varying heights and sizes)* ❑ D. Can more than one person read or hear it? *(e.g. text/audio directing the activity is large/loud enough to be read/heard by*		☐ Exhibit ☐ Interp.

multiple people clustered around the exhibit)		

3.3) In what ways are family members able to sit and share their experiences? ❑ A. Planned seating within activity area *(e.g., benches, stools, chairs that are a part of or immediately next to the activity area)* ❑ B. Planned seating outside of activity area *(e.g., benches or chairs that are not part of the activity and removed from the activity area)* ❑ C. Unplanned seating opportunities available *(e.g., steps, low retaining walls that were not purposely designed for seating but are used by family members for seating)* ❑ D. Seating that accommodates larger groups *(e.g., possible seating for groups larger than 6 members)*		☐ Exhibit ☐ Interp.

Appendix 2

Learning assessment tool

From Falk & Dierking (2003), adapted by Kevin Walker (2008)

BACKGROUND DATA

Date _____ Weekday / Weekend (*Circle one*) Initials of data collector _____

Crowd Level (*Circle One*) Very few visitors Moderate number of visitors Crowded

Time assessment begun: _____ am/pm

Observe one visitor group at a time. The evidence should support your decision to check or not check the boxes, including:

5) Visitor's focus of attention – e.g., museum staff; group members; visitors not in group; map or activity guide
6) Action – e.g., standing, looking; waiting; talking; inquiring
7) Group involved
8) Overheard conversation

Group — Description of group (Adult or Child; Male or Female; Apprx. Age)**:**

DIMENSION 1: SOCIO-CULTURAL	
1.1 In what ways is the experience engaging and thought-provoking?	
1.1a Connections to other experiences *(e.g., "Look, it's just like..." or "Doesn't this remind you of...?")*	Artefact, Exhibit or Other?
1.1b Elements of unpredictability *(e.g., surprising answers; or "Watch this, you'll never guess...")*	
1.1c Open-ended outcomes or different outcomes *(e.g., activity that allows you to construct insects adapted to different environments; or "Mine came out like this..." or "That's different from...")*	

1.1d Information relevant to current issues	
1.1e Engaging with artefacts, reproductions, or models in a way that challenges people to think about their functional or aesthetic use *(e.g., unusual perspectives)*	

1.2 In what ways do group members participate?	
1.2a The more experienced model participation for the less experienced *(e.g., child shows adult how to use touch screen; or, "Here, if you push this part first...")*	Artefact, Exhibit or Other?
1.2b Direction is provided to help group members draw out ideas or participation by others *(e.g., visitor reads label and repeats out loud; or, "Try and find the easiest way to ...."; or Staff suggestion leads to conversation.)*	
1.2c Meaningful observation as well as participation *(e.g., visitor can step back from action but still comment on)*	
1.2d Hands-on activity using artefacts, reproductions, or models. *(e,g., manipulating* artefacts*)*	

1.3 In what ways does the group collaborate or solve problems together?	
1.3a Two or more people perform an activity	Artefact, Exhibit or Other?
1.3b Designing or assigning roles *(e.g., putting together a play, or role-playing)*	
1.3c Turn-taking, collaborative, problem-solving	
1.3d Synthesizing or reflecting as a group	

1.4 In what ways do group members communicate?	
1.4a Share basic information or facts	Artefact, Exhibit or Other?
1.4b Compare something to themselves or other group members	
1.4c Talk about group history or identity	
1.4d Ask or answer close-ended (usually yes, no) questions, leading to identifications or descriptions	

1.4e Ask or answer open-ended questions that encourage explanations	
1.4f Explanations *(e.g., 'It is because...' or 'The reason why is that...')*	
1.4g Verbal and non-verbal communication *(e.g., gesture, writing, or drawing is used to provide feedback or share information)*	

Check (✓) all that apply to the trail	*Write evidence to support your decision to check or not check*	*Source(s) of evidence*
DIMENSION 2: PERSONAL AND CULTURAL		
2.1 Visit motivation and expectations [added by Kevin]		
2.2 Prior knowledge, experience, interests [added by Kevin]		
2.3 Modes of communication used by the group ❑ A. Text *(e.g., text messages, notes, email)* ❑ B. Physical contact or sensation ❑ C. Audio *(e.g., talking with museum staff or others)* ❑ D. Video ❑ E. Software *(e.g., computer-based communication)* ❑ F. Photographs, pictures, or drawing ❑ G. Artefacts or reproductions *(e.g., handling, manipulating* artefacts*)* ❑ H. Models *(e.g., interactive activities)* ❑ Human interpretation *(e.g. staff presenting 1st person script, greeter, or staff presenting unscripted information related to exhibit cluster)*		

2.4 Accommodation of group members with different abilities ❑ A. Vocabulary at different levels *(e.g., using 'meat-eater' at one point and 'carnivorous' at another)* ❑ B. Performing variety of tasks at different levels of difficulty ❑ C. Translating interpretive information into simpler language		Artefact, Exhibit or Other?

❑ D. Artefacts, reproductions, or models are used to illustrate concepts or provide information		
2.5 Multiple generations within a group ❑ A. Different periods of time (or artefacts from different periods of time) are contrasted ❑ C. Relating artefact/exhibit to current issues		

2.6 Diverse personal and cultural histories ❑ A. Explanations/discussions about a culturally-specific issue or context ❑ B. Connections to the local community ❑ C. Connections to a variety of geographical areas *(e.g., city v. rural life, or northern v. southern hemisphere)* ❑ D. Discussion of gender roles		Artefact, Exhibit or Other?
2.7 Choice and control over the visit [added by Kevin]		
DIMENSION 3: PHYSICAL		
3.1 Effect of the physical environment on the group (Architecture & macroscale factors) ❑ A. Traffic flows/crowding ❑ B. Ambient temperature ❑ C. Lighting ❑ D. Noise levels		Artefact, Exhibit or Other?
3.2 Accommodation of multiple group members ❑ A. Do multiple group members gather around? ❑ B. Does more than one group member actively participate? ❑ C. Do both children and adults participate? ❑ D. Does more than one person read, hear, speak or capture?		

3.3 Sharing experiences ❑ A. Seated in gallery or activity area		Artefact, Exhibit or Other?

❑ B. Seated outside of gallery or activity area ❑ C. Other [added by Kevin]		
3.4 Navigation & orientation [added by Kevin] ❑ A. Advance organizers ❑ B. Orientation of the space		
3.5 Design of exhibitions, programmes, and technology [added by Kevin] ❑ A. Exhibitions ❑ B. Programs ❑ C. Technology (related to exhibitions)		

Appendix 3: Activity Checklist

From Kaptelinin and Nardi (2006)

Means/ends

(hierarchical structure of activity)

Human beings have hierarchies of goals that emerge from attempts to meet their needs under current circumstances. Understanding the use of any technology should start with identifying the goals of target actions, which are relatively explicit, and then extending the scope of analysis both 'up' (to higher-level actions and activities) and 'down' (to lower-level actions and operations).

- People who use the technology
- Goals and subgoals of the target actions (target goals)
- Criteria for success or failure of achieving target goals
- Decomposition of target goals into subgoals
- Setting of target goals or subgoals
- Potential conflicts between target goals
- Potential conflicts between target goals and goals associated with other technologies and activities
- Resolution of conflicts between various goals
- Integration of individual target actions and other actions into higher-level actions
- Constraints imposed by higher-level goals on the choice and use of target technology
- Alternative ways to attain target goals through lower-level goals
- Troubleshooting strategies and techniques
- Support of mutual transformations between actions and operations

Environment

(object-orientedness)

Human beings live in the social, cultural world. They achieve their motives and goals by active transformations of objects in their environments. This section of the checklist identifies the objects involved in target activities and constituting the environment of the use of target technology.

- Role of target technology in producing the outcomes of target actions
- Tools, other than target technology, available to users
- Integration of target technology with other tools
- Access to tools and materials necessary to perform target actions
- Tools and materials shared between several users
- Spatial layout and temporal organisation of the work environment
- Division of labour, including synchronous and asynchronous distribution of work between different locations
- Rules, norms, and procedures regulating social interactions and coordination related to the use of target technology.

Learning/cognition/articulation

(externalisation/internalisation)

Activities include both internal (mental) and external components, which can tranform into each other. Computer systems should support both internalisation of new ways of action and articulation of mental processes, when necessary, to facilitate problem solving and social coordination.

- Components of target actions which are to be internalised
- Knowledge about target technology which resides in the environment and the way this knowledge is distributed and accessed
- Time and effort necessary to master new operations
- Self-monitoring and reflection through externalisation
- Use of target technology for simulating target actions before their actual implementation
- Support of problem articulation and help request in case of breakdowns
- Strategies and procedures of providing help to other users of target technology

- Coordination of individual and group activities through externalisation
- Use of shared representation to support collaborative work
- Individual contributions to shared resources of a group or organisation

Development

Activities undergo constant developmental transformations. Analysis of the history of target activities can help to reveal the main factors influencing the development. Analysis of potential changes in the environment can help to anticipate tehir effect on the structure of target activities.

- Use of target technology at various stages of target action 'life cycles' — from goal setting to outcomes
- Effect of implementation of target technology on the structure of target actions
- New higher-level goals which became attainable after the technology had been implemented
- Users' attitudes toward target technology (e.g., resistance) and how they change over time
- Dynamics of potential conflicts between target actions and higher-level goals
- Anticipated changes in the environment and the level of activity they directly influence (operations, actions, or activities)

Appendix 4

Transcript of trail of Rachel and Adam, 14 May 2006

0.00

R: OK Hi Kevin. This is Rachel.

0.06

R: Adam has decided that we should walk in the main entrance to get th best view of the installation in the turbine hall. We're outside the Tate Modern. We're just going in the turbine - the turbine hall.

A: And the installation has gone!

R: Oh no!

A: So there is no main installation

R: Oh that's too bad.

0.30

R: OK. So let's get a map. Oh, I'm disappointed. So I missed this one. I try to see - do we try to see every installation -

0.41. A: Yeah

R - in the turbine hall?

0.43. R: Of course our favourite was the sun

A: You know what the next one is don't you?

R: What?

A: The next one is the guy who does huge things hanging from the ceiling. I read about it.

R: Oh

A: He did one in New York, which was huge mushrooms...

R: You're sounding far too intelligent

A: (laughs) What do you mean, far too intelligent?

R: (laughs)

A: I'm gonna look for a Frank Lloyd Wright book in here

R: OK. I get a 10 percent discount in the bookstore.

A: Oh do you? OK.

1.07

R: OK so we need to decide if we're gonna see the exhibit, then I can get tickets I think on my Tate members card

1.17

A: I don't want to see the exhibit

R: OK. So we just have a wander

A: Yeah

R: Should we wander to the loos first?

A: Do you want to do that first? The loo's just down here

R: OK. Surprise, surprise

1.28

A: I'm gonna go into the shop while R goes to the toilet.

R: OK, this is typical.

[break]

1.33

R: OK. I'm not sure where we're going but we're going up an escalator. Um, Adam's pointing to a poster of a skip filled with rubbish, which is an exhibit by Martin Kippenberger. Do you want to go to that?

A: No.

R: No. Veto.

1.51

OK, are we just wandering, or -

A: Yeah

R - do we have a plan? No, we're just wandering. We could go see the Monet, 'cause, well, we have to make sure to watch the Monet programme tonight. It's been really advertised heavily on the radio...

2.10

R: There's something here, that's in the nature section. We have to go to the nature section. So now what is that called - nature...?

2.27

OK, we're getting to the top of the escalator. And... we're gonna go view the turbine hall. Which is empty

2.40

A: That's just such a wonderful negative use of space

R: laughs

A: It's just really inspiring..

R: It is kind of interesting watching people interacting in a blank space

2.55

A: First time we came in here there were just a few boxes, right -

R: Oh, uh huh

A: - here and there. When we got here it was just there were mountains and tunnels, right actually about, what, the height of these lights?

R: Oh right

A: One of the mountains?

R: Must be incredibly hard to design something for this space, 'cause you've got so many different ways of -

A: He just probably went up on there, to see what it looks like [referring to another visitor]

3.20

R: - interacting. [laughs] Look at those girls. These girls down there are taking pictures of each other across the hall. Rather kind of abstract pictures.

3.30

R: OK.

[break]

3.35

R: Alright, we're wandering into a room full of people. Oh, cool. What room is this? The Gilbert Scott gallery

3.50

There's a queue to look at this particular piece. Do you want to stand in the queue? OK.

4.00

We're looking at Barnett Newman, Adams. I guess we're not looking at it·

4.19

R: Ooh.

4.27

Wait, did you -

4.34

Oh I used to have - when I was at university I had a poster of a Giacometti on the wall.

A: A poster

R: Was always a bit bizarre. We're looking at Alberto Giacometti's 'Standing Women.' Three of them.

5.00

A: The one in the middle's OK but the two on the outside could do with a few pounds on

5.14

Look at this one - it's disgusting

R: Adam was referring to... bust of Diego. No, he wasn't. He was referring to... The Tree of Fluids, by Jean Dubuffet

5.53

R: OK now I'm still look at Giacometti, Four figurines on a base. 'Cause these other women were laughing at it, so I was kinda curious.

6.09

Um, it says, the artist's memory of sitting in a Paris brothel seeing four naked women at the far end of the room

6.23

Mm. It's about distance. And space.

6.33

OK I'm going into the next room. Looking at Kirchner. Bathers. Oh - 1909. Looks very 70s to me

6.57

We're you're looking at, Adam's looking at Karl Schmidt Rutolf, Male Head. He looks a bit worried, he has a furrowed brow.

7.13

A: OK

7.17

R: The Seabee. This is Emile Norde. I've never heard of Emile. It's a nice painting of the sea though

7.49

Mm.

7.54

Oh, that's a famous one. Oh, that's another famous one. We're moving into a room of really famous paintings. It's called Distinguished Voices in fact, the Monument Trust gallery

8.11

OK, I'm looking at the Miro, Message from a friend. And reading the description. OK now I'm moving over to the famous Matisse, which is on the cover of the Tate book that I have at home

8.29

I don't know anything about it actually, it's called The Snail

8.38

And I'm looking at the mobile [hanging artwork not phone], which I quite like. We don't really do enough with mobiles, do we?

8.55

Uh, this is called Antenna with red and blue dots. It's by Alexander Calder

9.04

OK I think that's enough of that room. We're going to... a room with a big pink painting at the end

A: Weston gallery

R: Weston gallery

9.18

Mm. I don't know if I wanna pause in here. Do you feel like - ? I think we're gonna walk through this room rather quickly

9.33

A: Picture of what appears to be a hooded male []

R: Yes. Hoodies [wean?]. Go see what the title is - is it Hoodies wean? Nope? It's called Ghost 1 and Ghost 2

A: Looks like Eminem

R: Is it really? By Eberhard Hevecos

10.02

Oh he's kind of a super-realist.

10.09.

Hm. Mm. OK. I think, um... we're going to the next room.

10.26

Oh, ha ha. Claude Monet and abstract expressionism. The Peter Simon gallery. American abstract painting of the 40s and 50s.

10.38

Ah we said 'hey' because, uh, Monet's water lillies are in here.

10.47

OK. So I just read the little blurb here. And I'm looking at a Rothko... which is... uh, to the side of the water lillies. So I'm kind of comparing them. As the blurb suggested.

11.11

Uh, the Rothko's Untitled C., 1950-1952.

11.27

And... Is that a Jackson Pollock?

11.36

Got a lot of people in here. So it's hard to get a decent look at the water lillies. So we're looking at the Jackson Pollock instead. I like this one.

11.59

I like how they, how the colours in the Rothko are the same as the colours in the water lillies.

12.18

Uh, now we're looking out the window to the spectacular view.

A: They're working on it, big canvas up, can you see?

R: Oh yeah, St. Pauls

A: Yeah, they do that in Rome -

R: Yeah yeah, the canvas has the painting of the, like, what's underneath

A: Because they're obviously doing some work

12.42

R: Uh, can you see any people up there on the -

A: No

R: - balcony?

12.53

It's a popular day to be wandering around London. Mm-kay, we're going into another... room with Franz Kline, Marion. Uh, we're passing through - that was a passing room. 'Material Gestures'.

13.23

A: Oh no that's depressing, let's go up.

13.27

Oh this is quite interesting - we came here last time.

R: Did you?

A: I came here with David, way back from -

R: Oh, that's right

13.34

Oh a whole Rothko room, cool. He was in the movie last night, in
the chick flick that Jo and I saw.
A: Who was?
R: Rothk - there was a painting, there was a moment in the movie that centred around a Rothko painting

13.47
It's quite dark in here...
A: So we're surrounded by Rothkos
R: ... I wonder why is that? Cool.

13.54
My sister takes her kids to the, the uh National Gallery in D.C. when they're studying colour. And looks at the Rothkos

14.10
A: Dark for my taste. I was much more -
R: Yeah why is that then?
A: - impressed by his orange period
R: [laughs] Orange is Adam's favourite colour. And these are all reds. And blacks

14.25
I'm gonna read the thingie, the blurb.

14.36
R: OK. Moving out of the Rothko room

14.17
And, turn left. We're looking at a slice in a canvas, called Nature - Oh I said I wanted to go to Nature. This is Lucio Fontana. I don't get it. Oh, is that the sculpture?
A: Yeah
R: Oh. OK. That looks more like a nature -
A: Looks like a gigantic ball of dinosaur poo to me.
R: OK and the sliced canvas is called Spatial Concept: Waiting

5.17

OK, moving quickly on. Moving out of this space. Um that queue by the liftside. Do you want me to carry the bag? Moving back past that exhibit that has a queue in front of it

15.28

What is that? It's like a - I don't know what it is. OK we're movin' on, to the escalators

15.53

Are you ready for coffee and cake yet?

A: I'm always ready for coffee and cake. Keep going up, don't we?

R: Yeah, let's keep going up

A: Six isn't it?

R: Right

A: The members' room

16.12

R: So we're going up the escalator. I do want to go to the Nature section. Can you look on the map where the Nature section is, please?

16.30

Uh. They don't have the titles on? They used to, when it first opened it was organised by kind of theme. It's all changed

16.52.

OK. Martin Kippenberger. Oh that's where the skip is. Do you want to go see the skip? Free to members. So I could go and get it. No. OK.

17.13

Oh I see. OK. Temporarily closed! Floor 5 is temporarily closed. Aww.

A: 7, restaurant and bar

R: Are we gonna go look at some, um, some other collections, first. Or are we gonna go straight to the coffee? Well there are other collections that we didn't see, I think, on floor 3.

17.40

But you're right, floor 4. Do you want to see those now, or d'you wanna -

A: Coffee

R: OK, and then come back?

17.52

OK, we're looking for a place to have coffee. But we got distracted by - Yeah, that's, I think this is part of the exhibit on modernism. This one. Do you want to go to that exhibit?

A: Hm, if that was [] it wouldn't be very good would it? Nice though, aren't they?

R: They're nice

18.17

OK.So, we're gonna have coffee now? Yeah?

18.35

Alright, the queue's too long so we're changing our minds.

A: We can't go up

R: We're wandering - we can't go up because the escalators are closed. So... we can... There's another restaurant on the ground floor. Or there's outside

A: Let's go down

18.57

And then we can decide what we wanna do next

19.05

A: If you want to know what we're doing at Tate Modern, we're milling around aimlessly

19.10

R: Now let's see, we used the sign on the wall, to figure out what each floor was about. And to figure out that floor 5 is closed. Which was not - Oh but I wonder if you can take a lift to floor 6? Which is where the members room is. Maybe it's just the escalators that are closed

19.35

A: Anywhere we can get coffee

R: Yeah, the members room has a bar in it. So yeah we could get coffee there. So we should - should we try the lift? Sorry?

A: Where are the lifts?

R: Umm, I think near the stairs, which are here

23.05

Uhhh - yes. OK so we're at the lifts on floor 3. And we're gonna see if we can get up to floor 6.

20.16

We could walk up.

20.27

Whoops. OK. This is a very small room.

20.34

A: Floor 7, yeah?

R: No, members room 6

A: Yeah but there's a restaurant up here as well.

R: Oh yeah.

A: You think you can get coffee there?

R: Yes. And we can go out on the balcony, and look over the river.

20.49

A: I forgot it's being recorded

R: Maybe it's just my teacher impulse

20.58

Oh I have to get my membership - OK. I'm shutting it off. We managed to get to the members room but I gotta get - OK. We've talked for 21 minutes.

A: Unusual

R: I stopped the recorder. I paused the recorder. So we probably spent a half an hour looking at art so far. [laughs] And now we're on the member's balcony which overlooks the river outside

A: Wow

[boat horn]

R: ...as you can hear!

A: good brownies

R: We're having coffee and brownie - [end]

[clip 2]

R: Track 2. 2:30 What?

A: Lunch

R: What? Oh on the boat.

0.15

A: On the river Seine? That's exactly what they're like

0.36

R: OK, what do you wanna do?

A: See some more art

R: Should we go to that exhibit? Kevin recommended it [laughs]

A: Sorry?

R: Kevin recommended it.

A: Kevin...

R: The guy we're doing this for

A: You gotta go all the way down and get the tickets

R: That's alright. You're not really into that.

A: Which one? I don't want to go to the skip one.

R: No, the other one. I don't know where - it doesn't say anything on the map? What it's about?

1.08

A: I gave you the map

1.18

This is the pizza menu [laughs]

R: [laughs]

1.33

R: This is the one. Bauhaus to the New World

1.44

We can just whiz through it

A: Yeah.

R: You like modernism. Some.

A: Yeah, I'm more into []

2.00

Alright, so we are moving on.

A: We could always ask at the desk. After we go out, we need to go out to buy tickets, or we just show our card.

R: Yeah yeah. I guess we can give it a try.

2.15

Yeah. No one's lounging today. It's not sunny enough. Oh. Hiya. To go to one of the special exhibits, do I need to -

Attendant: Just show your card

R: Oh I can just - I don't have to go and get tickets? OK brilliant. Cheers, thanks.

A: We'll go down the stairs.

R: OK, so... we're on floor 6 and we need to go to floor... what, 4?

A: 4

R: So we're walking down the stairs. And I left my card out. It's in my back pocket.

2.49

I love these floors. The wood is just fantastically kind of rustic. Nice.

3.02

Wonder what they're doing

3.12

And this is floor 5. 'Tate Modern is changing for the first time.' Gosh it's been six years. 'Focus on a key period of innovation.' Oh, I like the way it was before. I thought it was really inventive. They had themes, instead of going chronologically, which is kind of the standard museum thing.

3.34

A: Change is a good thing. Can't be afraid of change.

R: Yeah I guess I should have come more often when it was the way it was

3.50

A: I remember the first thing I saw here was, you came up the escalator

R: Yeah

A: That went to that first door, and there was a projector, and it was projecting a picture of a light switch onto the wall. Which I thought was really clever

R: [laughs]

4.06

A: Got your card?

R: Yeah, got my card.

4.13

Yeah.

4.19

Thank you. Thank you. OK. We're going into the Albers and Moholy-Nagy exhibit. It took me longer to read that than -

A: To walk around.

R: [laughs]

A: [laughs]

R: OK.We're in room 1. I'm gonna read the thing on the wall.'Cause that always helps me.

4.59

Ooh, OK.I'm looking at the, uh, glass. Um, this is called... Rainish legend

5.52

OK, I'm movin' on. Adam's miles ahead of me somewhere. I'm in room 2. Ah. The tables... um, the writing on the wall's crowded, so I'm not gonna read that. Have you figured out what this room is for?

A: This is room 2

R: [laughs] I have to read the catalogue

6.33

Have you seen anything you like?

A: I like those tables there

R: Mm.... Room 2. OK.

6.53

OK, now... I'm in, I don't know, 'Teaching Bauhaus'

7.18

[humming]

7.28

What?

A: 'School should allow a lot to be learned.' Which is just saying you should teach little.

R: [laughs] That's good. I should have had that in my classroom. Would have got me off the hook -

A: Sorry?

R: I should have had that in my classroom. Would have got me off the hook on a lot of things.

7.51

A: D'you want me to carry the bag?

R: Ooh yes please. Thank you.

A: This way or what?

R: OK. Oh wait, I just wanna look at these photos.

A: This way. That's room 2, that's room 9.

R: Oh, OK. I'm looking at a photo of... um, the Schlimmer girls on balcony. Hm. And some more photos next to that, of some dolls. Kind of looks like something on um - sorry?

8.28

A: Looks like the balconies at your flats. Same kind of idea though

R: Yeah...Hey now these are the kinds - have you ever been on the Flickr site? You got like those dolls, you got kinda images like that, on the Flickr site

8.47

Bauhaus balconies.

9.02

Telephone picture, hm. OK, we're moving into room... 3!

9.46

Um, I don't at, a whole wall of photographs, from, uh, kind of unusual perspectives

9.59.

Ooh, and um... unusual developing techniques

10.21

Umm...Now I'm moving across the hall...

11.03

OK, I'm moving into room 4...Um, and.. I just read the wall... blurb.

11.25

So now I'm looking at the photographs next to the blurb.

12.03

[to A] I could see some of those things in the flat. I could see some of those photographs in my flat.

12.12

OK, room 5

12.30

Um, I think we're gonna see light [] that we []... Oh good, it's just finished a cycle

13.02

Schwartz - that means black.

A: What's that mean?

R: That means black. Schwartz.

13.45

A: []... late hours shift in here...

R: What made that ball move? Oh

A: Sorry?

R: What made that ball move? Did you see the ball move?

A: No

R: [gasp]

A: Did it go up and down?

R: Yeah it rolls, along the track. OK, it's coming around. D'you see the ball? It rolled along that track.

A: OK.

R: Wup, wup, is the track going up?

A: It's tilting down. Yeah, that thing has moved up.

R: Whoa. Ok so what's making the big round move up

A: Well it's a motor

R: Really?

14.29

A: Could use a cheese grater there, that's really nice isn't it?

14.40

Looks like something from a Doctor Who set

R: [laughs]

A: ... cybermen

R: Yeah. That's what happened when the tardis crashed.

14.52

A: It's giving me a headache.

R: Look at the shadow on the wall. That's pretty cool... I don't know what the film is about.

15.06

It's rather grey.

15.33

OK. Ready to move on?

A: Want to see the ball move

R: There it goes there it goes there it goes

[click]

R: Mm, OK.

A: OK.

16.01

R: OK. We're moving... to... um... room 6.

16.21

Black Mountain College. Sounds like a good place to teach.

16.30

Did you like those glass things at the beginning? Those are my favourite so far.

16.59

OK we just kinda walked through that room...so I'm now in room 7.

17.38

OK. You can see how he created a visual language for the underground

18.22

Oh wow, I like the photographs.

18.52

OK. Moving on. Room... Ooh, colourful room... 8.

19.35

When was, um, that Rothko? When did Rothko paint?

A: [80s, 90s] or something?

R: So same time.

A: I don't know

R: Don't know either.

19.51

Is that Mexico?

20.03

OK.

20.10

We're in another room.

20.26

This is room 9. Taking perspex to many levels

20.48

I'm quickly gonna move over to the photographs. Oops, I'm confused.

20.58

Is this a new room? I think we're gonna come back to that room. It's a bit confusing. OK. I'm in room 10 now

21.27

Oh, I'm looking at these drawings. Huh.

21.28

OK, it's time to sit down again and watch a film. Room 11. [whispers] What is this? Oh. Experimenting with coloured slides

22.26

A [whispering]: You just missed one of a cat.

24.11

R: OK.

A: 5 more. 4 more.... 3 more... That's out of focus isn't it? 2 more. That one's not that bad... one more.... There's the cat again

24.40

I like this one. It looks better on a - in print. Study with pins and ribbons.

24.58

Room 12.

A: Homage to the sky.

R: [laughs]

25.16

I think this is about... about colours

25.38

OK. Adam's ready to go, so we'll head out. You ready to go? OK.

25.51

Whoa. Looking grey out now

26.08

Would you recognise a Bauhaus when you see it, if you saw it?

26.22

OK. Well we've done part of floor 3 and part of floor 4. And of course floor 6, which is very important. Ready to wander back to Waterloo? Ok we're going down the escalator

[clip 3]

R: Oops. Oh gosh, it started a third track. Uh, we're going shopping. We're going down the escalator.... What are you - are you looking for something in the shop?... OK. You're not gonna suddenly... invest in Bauhaus

A: No. If I'd have invested in it in the 30s that would have been alright

R: Mm.

0.40

A: I wasn't impressed I'm afraid. I'm sorry.

0.52

R: We're looking at a Frank Lloyd Wright picture.

A: Spring Rain

R: Oh it's in [Spring Rain]

A: How far is that from you?

R: Oh about an hour drive from Madison... Huh - R.W. Willet's house

1.12

A: Don't know who designed all these Taschen books, they're all much smaller now. Yeah?

R: Oh

A: Used to get the big ones

R: Yeah yeah yeah

1.42

OK we're trying to get out of the shop

A: [laughs]

R: We're going through some sliding doors. Which is a surprise. 'Cause we came out the other end of the shop

1.56

And...we are leaving the same way we came in... through the main doors to the turbine hall

2.05

[laughing] That was our navigation -

A: Sorry?

R: That was our Sunday navigation of Tate Modern

A: Out the way we came in, always the best way

R: Anything else to say to Kevin?

A: Sorry?

R: Anything else you'd like to say to Kevin?

A: Uh, no. It's been very nice though. It's been a pleasure sharing our afternoon with you.

R: OK. Hope that was helpful. Bye

Appendix 5
Filled-in Learning assessment tools for the three trails in Ch. 6

Trail 1 (Keith)

BACKGROUND DATA
V&A Museum Date 15 Feb 2006 Weekday Initials of data collector KW

Crowd Level: low

Time trail begun: 13.14.51 (1.14pm)

Observe one visitor group at a time. The evidence should support your decision to check or not check the boxes, including:

9) Visitor's focus of attention – e.g., museum staff; group members; visitors not in group; map or activity guide
10) Action – e.g., standing, looking; waiting; talking; inquiring
11) Group involved
12) Overheard conversation

Group — Description of group (Adult or Child; Male or Female; Apprx. Age)**:**
Adult male, late 30s/early 40s

DIMENSION 1: SOCIO-CULTURAL	
1.1) In what ways is the experience engaging and thought-provoking?	
1.1a Connections to other experiences *(e.g., "Look, it's just like..." or "Doesn't this remind you of...?")* N/A	Artefact, exhibit or other?
1.1b Elements of unpredictability *(e.g., surprising answers; or "Watch this, you'll never guess...")* Recording 3: '...something quite unusual - a carved Chinese cabbage...Un, sort of jumps out of the case as something quite unusual in relation to everything else - sort of pots and stoneware plates and things like that'	artefact

1.1c Open-ended outcomes or different outcomes *(e.g., activity that allows you to construct insects adapted to different environments; or "Mine came out like this..." or "That's different from...")* N/A	Artefact, exhibit or other?
1.1d Information relevant to current issues N/A	
1.1e Engaging with artefacts, reproductions, or models in a way that challenges people to think about their functional or aesthetic use *(e.g., unusual perspectives)* N/A	

1.2 In what ways do group members participate?	
1.2a The more experienced model participation for the less experienced *(e.g., child shows adult how to use touch screen; or, "Here, if you push this part first...")* N/A	Artefact, exhibit or other?
1.2b Direction is provided to help group members draw out ideas or participation by others *(e.g., visitor reads label and repeats out loud; or, "Try and find the easiest way to ...."; or Staff suggestion leads to conversation.)* N/A	
1.2c Meaningful observation as well as participation *(e.g., visitor can step back from action but still comment on)* N/A	
1.2d Hands-on activity using artefacts, reproductions, or models. *(e,g., manipulating objects)* N/A	

1.3) In what ways does the group collaborate or solve problems together?	
1.3a Two or more people perform an activity N/A	Artefact, exhibit or other?
1.3b Designing or assigning roles *(e.g., putting together a play, or role-playing)* N/A	
1.3c Turn-taking, collaborative, problem-solving N/A	
1.3d Synthesizing or reflecting as a group N/A	

1.4) In what ways do group members communicate?	
1.4a Share basic information or facts [All trail stops contain basic artefact identification/description]	Artefact, exhibit or other?
1.4b Compare something to themselves or other group members N/A	
1.4c Talk about group history or identity N/A	
1.4d Ask or answer close-ended (usually yes, no) questions, leading to identifications or descriptions N/A	
1.4e Ask or answer open-ended questions that encourage explanations N/A	
1.4f Explanations *(e.g., 'It is because...' or 'The reason why is that...')* N/A	
1.4g Verbal and non-verbal communication *(e.g., gesture, writing, or drawing is used to provide feedback or share information)* N/A	

Check (✓) all that apply to the trail	*Write evidence to support your decision to check or not check*	*Source(s) of evidence*
DIMENSION 2: PERSONAL AND CULTURAL		
2.1 Visit motivation and expectations	Prompted by me, though he is regular visitor; appears to be first time in China gallery but does not state why visited it	recording
2.2 Prior knowledge, experience, interests	All trail stops appear to be motivated by aesthetic interest, esp. artefacts unusual in relation to other artefacts	recording
2.3 Modes of communication used by the group ❑ A. Text *(e.g., text messages, notes, email)* ❑ B. Physical contact or sensation C. Audio *(e.g., talking with museum staff or others)* ❑ D. Video	[The recording generally]	Artefact, exhibit or other?

❑ E. Software *(e.g., computer-based communication)* ❑ F. Photographs, pictures, or drawing ❑ G. Artefacts or reproductions *(e.g., handling, manipulating artefacts)* ❑ H. Models *(e.g., interactive activities)* ❑ Human interpretation *(e.g. staff presenting 1st person script, greeter, or staff presenting unscripted information related to exhibit cluster)*		

2.4 Accommodation of group members with different abilities ❑ A. Vocabulary at different levels *(e.g., using 'meat-eater' at one point and 'carnivorous' at another)* ❑ B. Performing variety of tasks at different levels of difficulty ❑ C. Translating interpretive information into simpler language ❑ D. Artefacts, reproductions, or models are used to illustrate concepts or provide information	N/A	Artefact, exhibit or other?
2.5 Multiple generations within a group ❑ A. Different periods of time (or artefacts from different periods of time) are contrasted ❑ C. Relating artefact/exhibit to current issues	N/A	Artefact, exhibit or other?

2.6 Diverse personal and cultural histories A. Explanations/discussions about a culturally-specific issue or context ❑ B. Connections to the local community ❑ C. Connections to a variety of geographical areas *(e.g., city v. rural life, or northern v. southern hemisphere)* ❑ D. Discussion of gender roles	N/A [All are related to China or Taiwan; one piece from Canada]	Artefact, exhibit or other?

	N/A	
2.7 Choice and control over the visit [added by Kevin]	All trail stops appear to be motivated by aesthetic interest, esp. artefacts unusual in relation to other artefacts	Recording
DIMENSION 3: PHYSICAL		
3.1 Effect of the physical environment on the group (Architecture & macroscale factors) A. Traffic flows/crowding ❑ B. Ambient temperature C. Lighting ❑ D. Noise levels	N/A	Artefact, exhibit or other?
3.2 Accommodation of multiple group members ❑ A. Do multiple group members gather around? ❑ B. Does more than one group member actively participate? ❑ C. Do both children and adults participate? ❑ D. Does more than one person read, hear, speak or capture?	N/A	

3.3 Sharing experiences ❑ A. Seated in gallery or activity area ❑ B. Seated outside of gallery or activity area ❑ C. Other [added by Kevin]	N/A	Artefact, exhibit or other?
3.4 Navigation & orientation [added by Kevin] ❑ A. Advance organizers ❑ B. Orientation of the space	See trail, Section 6.3.1	
3.5 Design of exhibitions, programmes, and technology [added by Kevin] ❑ A. Exhibitions ❑ ❑ ❑ B. Programs ❑ C. Technology (related to exhibitions)	Design of the gallery frames themes in the trail: from the 'Ruling' and 'Living' sections through to 'Collecting,' then 'Burial' . See Section 6.3.1	

Trail 2 (Tim)

BACKGROUND DATA
British Museum Date 14 Mar 2006 Weekday Initials of data collector KW

Crowd Level: unknown

Time trail begun: 14.20.53 (2.20pm)

Observe one visitor group at a time. The evidence should support your decision to check or not check the boxes, including:

13) Visitor's focus of attention – e.g., museum staff; group members; visitors not in group; map or activity guide
14) Action – e.g., standing, looking; waiting; talking; inquiring
15) Group involved
16) Overheard conversation

Group — Description of group (Adult or Child; Male or Female; Apprx. Age)**:**
Adult male, late 30s/early 40s

DIMENSION 1: SOCIO-CULTURAL	
1.1) In what ways is the experience engaging and thought-provoking?	
1.1a Connections to other experiences *(e.g., "Look, it's just like..." or "Doesn't this remind you of...?")* Recording 2.2 'Um, I kinda wanna go and see the Easter Island figure because after reading *Collapse*, I got really interested in Easter Island...'	Artefact, exhibit or other? Easter Is. figure
1.1b Elements of unpredictability *(e.g., surprising answers; or "Watch this, you'll never guess...")* Recording 2.1: 'You know, to be able to pull off that kind of detail is amazing to me' Recording 2.3: 'Um, it's kinda short. I mean you always think of the Easter Island statues and you think they're gonna be a lot taller, but this one's pretty short' Recording 2.4: 'Just layers and layers and layers of pills'	 Chinese temple bells Easter Is. figure 'Cradle to Grave' installation

1.1c Open-ended outcomes or different outcomes *(e.g., activity that allows you to construct insects adapted to different environments; or "Mine came out like this..." or "That's different from...")* N/A	Artefact, exhibit or other?
1.1d Information relevant to current issues Recording 2.2 'Um, I kinda wanna go and see the Easter Island figure because after reading *Collapse*, I got really interested in Easter Island and how the um, they basically chopped down all the trees, and how that had everything to do with why the society died. And you know, he mentions in the book that you really just kinda wonder, What would make you chop down the last tree?' Recording 2.5 '"...one man and one woman's life, and the various drugs they've taken over the course of a lifetime." And um, that's a lot of drugs. It's actually pretty cool when you look at it that way.'	Easter Is. figure Cradle to Grave installation
1.1e Engaging with artefacts, reproductions, or models in a way that challenges people to think about their functional or aesthetic use *(e.g., unusual perspectives)* N/A	

1.2 In what ways do group members participate?	
1.2a The more experienced model participation for the less experienced *(e.g., child shows adult how to use touch screen; or, "Here, if you push this part first...")* N/A	Artefact, exhibit or other?
1.2b Direction is provided to help group members draw out ideas or participation by others *(e.g., visitor reads label and repeats out loud; or, "Try and find the easiest way to ...."; or Staff suggestion leads to conversation.)* N/A	
1.2c Meaningful observation as well as participation *(e.g., visitor can step back from action but still comment on)* N/A	
1.2d Hands-on activity using artefacts, reproductions, or models. *(e,g., manipulating objects)* N/A	

1.3) In what ways does the group collaborate or solve problems together?

1.3a Two or more people perform an activity N/A	Artefact, exhibit or other?
1.3b Designing or assigning roles *(e.g., putting together a play, or role-playing)* N/A	
1.3c Turn-taking, collaborative, problem-solving N/A	
1.3d Synthesizing or reflecting as a group N/A	

1.4) In what ways do group members communicate?	
1.4a Share basic information or facts	Artefact, exhibit or other?
Recording 1 'bronze temple bells from the Qing dynasty, 1644 to 1911'	Chinese temple bells
Recording 2.2 '"...underscores how people everywhere deal with the tough realities of life, the challenges we all share with their many different responses."	Interpretive label text for Cradle to Grave
Recording 2.3 "Hakananai'a - probably stolen or hidden friend." Um, was donated to the museum by Queen Victoria, interestingly enough.	Interpretive label text for Easter Is. figure
Recording 2.4 And, photos around the edge, of people from, you know various either illnesses, some x-rays, so-and-so taking his pills.	Description of Cradle to Grave installation
Recording 2.5 '"...one man and one woman's life, and the various drugs they've taken over the course of a lifetime."	Interpretive label text for Cradle to Grave
1.4b Compare something to themselves or other group members	
Recording 2.3 'I mean you always think of the Easter Island statues and you think they're gonna be a lot taller, but this one's pretty short.'	Easter Is. figure
1.4c Talk about group history or identity N/A	
1.4d Ask or answer close-ended (usually yes, no) questions, leading to identifications or descriptions N/A	
1.4e Ask or answer open-ended questions that encourage explanations	
Recording 2.2 'What would make you chop down the last tree?'	Easter Is. figure

1.4f Explanations *(e.g., 'It is because...' or 'The reason why is that...')* Recording 2.2 'they basically chopped down all the trees, and how that had everything to do with why the society died'	Easter Is. figure
1.4g Verbal and non-verbal communication *(e.g., gesture, writing, or drawing is used to provide feedback or share information)* N/A	

Check (✓) all that apply to the trail	*Write evidence to support your decision to check or not check*	*Source(s) of evidence*
DIMENSION 2: PERSONAL AND CULTURAL		
2.1 Visit motivation and expectations	Prompted by me; appeared to be undirected visit	recording
2.2 Prior knowledge, experience, interests	Recording 2.2 '...after reading *Collapse...*'	Easter Is. figure
2.3 Modes of communication used by the group ❑ A. Text *(e.g., text messages, notes, email)* ❑ B. Physical contact or sensation C. Audio *(e.g., talking with museum staff or others)* ❑ D. Video ❑ E. Software *(e.g., computer-based communication)* ❑ F. Photographs, pictures, or drawing ❑ G. Artefacts or reproductions *(e.g., handling, manipulating artefacts)* ❑ H. Models *(e.g., interactive activities)* ❑ Human interpretation *(e.g. staff presenting 1st person script, greeter, or staff presenting unscripted information related to exhibit cluster)*	[The recording generally]	Artefact, exhibit or other?
2.4 Accommodation of group members with different abilities ❑ A. Vocabulary at different levels *(e.g., using 'meat-eater' at one point and 'carnivorous' at another)* ❑ B. Performing variety of tasks at different	N/A	Artefact, exhibit or other?

levels of difficulty ❑ C. Translating interpretive information into simpler language ❑ D. Artefacts, reproductions, or models are used to illustrate concepts or provide information		
2.5 Multiple generations within a group ❑ A. Different periods of time (or artefacts from different periods of time) are contrasted ❑ C. Relating artefact/exhibit to current issues	N/A	Artefact, exhibit or other?

2.6 Diverse personal and cultural histories A. Explanations/discussions about a culturally-specific issue or context ❑ B. Connections to the local community ❑ C. Connections to a variety of geographical areas *(e.g., city v. rural life, or northern v. southern hemisphere)* ❑ D. Discussion of gender roles	Recording 2.2 Um, I kinda wanna go and see the Easter Island figure because after reading *Collapse*, I got really interested in Easter Island and how the um, they basically chopped down all the trees, and how that had everything to do with why the society died. And you know, he mentions in the book that you really just kinda wonder, What would make you chop down the last tree?' Recording 2.5 '"...one man and one woman's life, and the various drugs they've taken over the course of a lifetime." And um, that's a lot of drugs. It's actually pretty cool when you look at it that way.' N/A N/A N/A	Artefact, exhibit or other? Easter Is. figure Cradle to Grave
2.7 Choice and control over the visit [added by Kevin]	Recording 2.2 'Um, I kinda wanna go and see the Easter Island figure'	Easter Is. figure
DIMENSION 3: PHYSICAL		
3.1 Effect of the physical environment on the		Artefact, exhibit

group (Architecture & macroscale factors) A. Traffic flows/crowding ❑ B. Ambient temperature C. Lighting ❑ D. Noise levels	Recording 1 '...Chinese section looking at, a bunch of schoolgirls.'	or other? Crowds
3.2 Accommodation of multiple group members ❑ A. Do multiple group members gather around? ❑ B. Does more than one group member actively participate? ❑ C. Do both children and adults participate? ❑ D. Does more than one person read, hear, speak or capture?	N/A	

3.3 Sharing experiences ❑ A. Seated in gallery or activity area ❑ B. Seated outside of gallery or activity area ❑ C. Other [added by Kevin]	N/A	Artefact, exhibit or other?
3.4 Navigation & orientation [added by Kevin] ❑ A. Advance organizers ❑ B. Orientation of the space	N/A	
3.5 Design of exhibitions, programmes, and technology [added by Kevin] ❑ A. Exhibitions ❑ ❑ ❑ B. Programs ❑ C. Technology (related to exhibitions)	Recording 2.4 'the thing that strikes me about is, this really doesn't tell me anything about this whole line of pills in front of me. It just uses them as sort of, wallpaper.' [resolved in Recording 2.5]	Cradle to Grave

Trail 3 (Rachel and Adam)

BACKGROUND DATA
Tate Modern Date 14 May 2006 Weekday / Weekend (*not known*) Initials of data collector KW

Crowd Level: Crowded

Time trail begun: Not known

Observe one visitor group at a time. The evidence should support your decision to check or not check the boxes, including:

17) Visitor's focus of attention – e.g., museum staff; group members; visitors not in group; map or activity guide
18) Action – e.g., standing, looking; waiting; talking; inquiring
19) Group involved
20) Overheard conversation

Group — Description of group (Adult or Child; Male or Female; Apprx. Age)**:**
Adult pair, male & female, late 30s/early 40s

DIMENSION 1: SOCIO-CULTURAL
1.1) In what ways is the experience engaging and thought-provoking?

1.1a Connections to other experiences *(e.g., "Look, it's just like..." or "Doesn't this remind you of...?")*	Object, exhibit or other?
0.43 R: Of course our favourite was the sun [Turbine hall]	Turbine hall
1.51 we have to make sure to watch the Monet programme tonight	reference to Monet painting
2.55 A: First time we came in here there were just a few boxes, right – [Turbine hall]	Turbine hall
4.34 Oh I used to have - when I was at university I had a poster of a Giacometti n the wall.	Giacometti sculpture
8.11 OK now I'm moving over to the famous Matisse, which is on the cover of the Tate book that I have at home	Matisse painting
12.18 A: Yeah, they do that in Rome –	Other: St Pauls under renovation
13.27 Oh this is quite interesting - we came here last time.	Gallery?
13.34 Oh a whole Rothko room, cool. He was in the movie last night	Artist
16.30 Uh. They don't have the titles on? They used to, when it first opened it was organised by kind of theme	Gallery
Clip 2 0.15 A: On the river Seine? That's exactly what they're like	Other: Boat outside Museum
3.12 Oh, I like the way it was before	Unidentified object
7.28 I should have had that in my classroom.	web site
8.28 have you ever been on the Flickr site?	Moholy-Nagy sculpture
14.40 Looks like something from a Doctor Who set	Book in Bauhaus exhibition
16.21 Black Mountain College. Sounds like a good place to teach.	

1.1b Elements of unpredictability *(e.g., surprising answers; or "Watch this, you'll never guess...")* 0.06 A: And the installation has gone! 11.59 I like how they, how the colours in the Rothko are the same as the colours in the water lillies.	Object, exhibit or other? Installation in Turbine Hall Rothko & Monet paintings
1.1c Open-ended outcomes or different outcomes *(e.g., activity that allows you to construct insects adapted to different environments; or "Mine came out like this..." or "That's different from...")* N/A	
1.1d Information relevant to current issues 9.33 A: Looks like Eminem	 Painting
1.1e Engaging with objects, reproductions, or models in a way that challenges people to think about their functional or aesthetic use *(e.g., unusual perspectives)* N/A	Object, exhibit or other?

1.2 In what ways do group members participate?	
1.2a The more experienced model participation for the less experienced *(e.g., child shows adult how to use touch screen; or, "Here, if you push this part first...")* N/A	Object, exhibit or other?
1.2b Direction is provided to help group members draw out ideas or participation by others *(e.g., visitor reads label and repeats out loud; or, "Try and find the easiest way to ...."; or Staff suggestion leads to conversation.)* N/A	
1.2c Meaningful observation as well as participation *(e.g., visitor can step back from action but still comment on)* N/A	
1.2d Hands-on activity using objects, reproductions, or models. *(e,g., manipulating objects)* N/A	

1.3) In what ways does the group collaborate or solve problems together?	
1.3a Two or more people perform an activity N/A	Object, exhibit or other?
1.3b Designing or assigning roles *(e.g., putting together a play, or role-playing)* N/A	

1.3c Turn-taking, collaborative, problem-solving N/A	
1.3d Synthesizing or reflecting as a group 13.45 R: What made that ball move? Did you see the ball move?	Moholy-Nagy sculpture

1.4) In what ways do group members communicate?	
1.4a Share basic information or facts	Object, exhibit or other?
0.30 A: The next one is the guy who does huge things hanging from the ceiling. I read about it.	Turbine Hall installation
9.33 It's called Ghost 1 and Ghost 2	Painting
10.02 Oh he's kind of a super-realist	Painting
7.28 A: 'School should allow a lot to be learned.'	Bauhaus artefact
16.21 Black Mountain College.	Bauhaus book
Clip 3 0.52 Huh - R.W. Willet's house	Photo
1.4b Compare something to themselves or other group members	
8.28 A: Looks like the balconies at your flats. Same kind of idea though	Photo in Bauhaus exhibition
12.03 I could see some of those things in the flat. I could see some of those photographs in my flat.	Photo in Bauhaus exhibition

1.4c Talk about group history or identity	
0.43 R: Of course our favourite was the sun	Ref. to Eliasson installation
8.38 We don't really do enough with mobiles, do we?	Calder mobile
13.54 My sister takes her kids to the, the uh National Gallery in D.C. when they're studying colour. And looks at the Rothkos	Artist
14.10 Orange is Andy's favourite colour.	Rothko painting
Clip 2 12.03 I could see some of those things in the flat. I could see some of those photographs in my flat.	Artefacts in Bauhaus exhibition
1.4d Ask or answer close-ended (usually yes, no) questions, leading to identifications or descriptions	
0.30 A: You know what the next one is don't you?	Turbine Hall installation
2.55 When we got here it was just there were mountains and tunnels, right actually about, what, the height of these lights?	Turbine Hall installation
11.27 Is that a Jackson Pollock?	Painting
12.18 A: They're working on it, big canvas up, can you see?	Other: St Pauls
14.17 Oh, is that the sculpture?	Artefact
15.28 What is that?	Unidentified
Clip 2 5.52 Have you figured out what this room is for?	Unidentified gallery
13.02 A: What's that mean?	Unidentified
13.45 What made that ball move?	Moholy-Nagy sculpture
19.35 When did Rothko paint?	Artist
19.51 Is that Mexico?	Painting
21.28 What is this?	Unidentified
24.11 That's out of focus isn't it?	Moholy-Nagy film
26.08 Would you recognise a Bauhaus when you see it, if you saw it?	Exhibition

1.4e Ask or answer open-ended questions that encourage explanations	
13.47 I wonder why is that?	Gallery
14.10 R: Yeah why is that then?	Artefacts
1.4f Explanations *(e.g., 'It is because...' or 'The reason why is that...')*	
2.55 A: He just probably went up on there, to see what it looks like [referring to another visitor]	Other visitor
12.18 R: Yeah yeah, the canvas has the painting of the, like, what's underneath	St Pauls
9.59 Ooh, and um... unusual developing techniques	Photos in Bauhaus exhibition
13.45 R: Yeah it rolls, along the track.	Moholy-Nagy sculpture
1.4g Verbal and non-verbal communication *(e.g., gesture, writing, or drawing is used to provide feedback or share information)* N/A	

Check (✓) all that apply to the trail	*Write evidence to support your decision to check or not check*	*Source(s) of evidence*
DIMENSION 2: PERSONAL AND CULTURAL		
2.1 Visit motivation and expectations	[Prompted by me, though they are regular visitors]	
	They expected to see a particular installation but it had closed already	Clip 1 0.06
2.2 Prior knowledge, experience, interests	0.30 I try to see - do we try to see every installation –	Turbine Hall
	0.30 A: He did one in New York, which was huge mushrooms...	Artist
	0.30 A: I'm gonna look for a Frank Lloyd Wright book in here	Other
	4.34 Oh I used to have - when I was at university I had a poster of a Giacometti on the wall.	Giacometti sculpture
	7.54 Oh, that's a famous one. Oh, that's another famous one.	Unidentified paintings

	8.11 OK now I'm moving over to the famous Matisse, which is on the cover of the Tate book that I have at home	Matisse painting
	8.29 I don't know anything about it actually, it's called The Snail	Painting
	10.38 Ah we said 'hey' because, uh, Monet's water lillies are in here.	Gallery/Artist
	14.10 A: - impressed by his orange period	Artist (Rothko)
	Clip 2 1.44 R: You like modernism. Some.	Exhibition
	3.12 Oh, I like the way it was before.	Museum
	3.50 A: I remember the first thing I saw here was, you came up the escalator	Museum
	13.02 Schwartz - that means black.	Moholy-Nagy film
2.3 Modes of communication used by the group ❑ A. Text *(e.g., text messages, notes, email)* ❑ B. Physical contact or sensation C. Audio *(e.g., talking with museum staff or others)* ❑ D. Video ❑ E. Software *(e.g., computer-based communication)* ❑ F. Photographs, pictures, or drawing ❑ G. Objects or reproductions *(e.g., handling, manipulating objects)* ❑ H. Models *(e.g., interactive activities)* ❑ Human interpretation *(e.g. staff presenting 1st person script, greeter, or staff presenting unscripted information related to exhibit cluster)*	[The recording generally] Clip 2, 2.15 R: To go to one of the special exhibits, do I need to - Attendant: Just show your card R: Oh I can just - I don't have to go and get tickets? OK brilliant. Cheers, thanks. [This is an art museum - see text]	Object, exhibit or other?

2.4 Accommodation of group members with different abilities ❑ A. Vocabulary at different levels *(e.g., using 'meat-eater' at one point and 'carnivorous' at another)* ❑ B. Performing variety of tasks at different levels of difficulty ❑ C. Translating interpretive information into simpler language ❑ D. Objects, reproductions, or models are used to illustrate concepts or provide information	N/A	Object, exhibit or other?
2.5 Multiple generations within a group ❑ A. Different periods of time (or objects from different periods of time) are contrasted ❑ C. Relating object/exhibit to current issues	N/A	Object, exhibit or other?

2.6 Diverse personal and cultural histories		Object, exhibit or other?
A. Explanations/discussions about a culturally-specific issue or context	5.00 A: The one in the middle's OK but the two on the outside could do with a few pounds on 9.33 Go see what the title is - is it Hoodies wean? Clip 2 7.28 R: I should have had that in my classroom. Would have got me off the hook on a lot of things.	Giacometti sculpture Painting Artefact in Bauhaus exhibition
❑ B. Connections to the local community		Crowds
❑ C. Connections to a variety of geographical areas *(e.g., city v. rural life, or northern v. southern hemisphere)*	12.53 It's a popular day to be wandering around London	
❑ D. Discussion of gender roles	N/A	
	5.00 A: The one in the middle's OK but the two on the outside could do with a few pounds on	Giacometti sculpture Giacometti

	5.53 R: OK now I'm still look at Giacometti, Four figurines on a base. 'Cause these other women were laughing at it, so I was kinda curious. 6.09 Um, it says, the artist's memory of sitting in a Paris brothel seeing four naked women at the far end of the room	sculpture Picasso?
2.7 Choice and control over the visit [added by Kevin]	0.06 R: Andy has decided that we should walk in the main entrance 0.30 A: I'm gonna look for a Frank Lloyd Wright book in here 1.07 R: OK so we need to decide if we're gonna see the exhibit 1.51 R - do we have a plan? 9.18 Mm. I don't know if I wanna pause in here. Do you feel like - ? I think we're gonna walk through this room rather quickly 15.53 Are you ready for coffee and cake yet? 16.52 Do you want to go see the skip? 17.13 R: Are we gonna go look at some, um, some other collections, first. Or are we gonna go straight to the coffee? Clip 2: 0.36 R: OK, what do you wanna do? 7.51 R: OK. Oh wait, I just wanna look at these photos. 15.33 OK. Ready to move on? 25.38 OK. Andy's ready to go, so we'll head out. 26.22 What are you - are you looking for something in the shop?	Museum Shop Bauhaus exhibition Artefacts Other Kippenberger Sculpture Other Other photos in Bauhaus exhibition other other shop
DIMENSION 3: PHYSICAL		
3.1 Effect of the physical environment on the		Object, exhibit

group (Architecture & macroscale factors) A. Traffic flows/crowding ❑ B. Ambient temperature C. Lighting ❑ D. Noise levels	 3.35_R: Alright, we're wandering into a room full of people. 11.36 Got a lot of people in here. So it's hard to get a decent look at the water lillies. So we're looking at the Jackson Pollock instead. 15.17 Moving back past that exhibit that has a queue in front of it 18.35 Alright, the queue's two long so we're changing our minds. Clip 2 5.52 The tables... um, the writing on the wall's crowded, so I'm not gonna read that. 13.47 It's quite dark in here...	or other? Gallery Paintings Exhibition Exhibition Exhibition: text gallery
3.2 Accommodation of multiple group members ❑ A. Do multiple group members gather around? ❑ B. Does more than one group member actively participate? ❑ C. Do both children and adults participate? ❑ D. Does more than one person read, hear, speak or capture?	 Yes - many instances (see Section 6.4.1) Yes - many instances (see Section 6.4.1) N/A Yes - many instances (see Section 6.4.1)	 various various various

3.3 Sharing experiences ❑ A. Seated in gallery or activity area ❑ B. Seated outside of gallery or activity area ❑ C. Other [added by Kevin]	N/A 21.00 And now we're on the member's balcony which overlooks the river outside Clip 3, 0.5: R: We're looking at a Frank Lloyd Wright picture.... Clip 3, 1.12 A: Don't know who designed all these Taschen books, they're all much smaller now.	Object, exhibit or other? cafe shop shop
3.4 Navigation & orientation [added by Kevin] ❑ A. Advance organizers ❑ B. Orientation of the space	0.06 We're outside the Tate Modern. We're just going in the turbine - the turbine hall. 1.17 R: OK. So we just have a wander 1.33 R: OK. I'm not sure where we're going but we're going up an escalator. 9.04 . We're going to... a room with a big pink painting at the end 10.09 I think, um... we're going to the next room. 12.18 Uh, now we're looking out the window to the spectacular view. 13.34 Oh a whole Rothko room, cool. 15.28 OK we're movin' on, to the escalators 15.53 Keep going up, don't we? 16.12 Can you look on the map where the Nature section is, please? 17.13 Oh I see. OK. Temporarily closed! Floor 5 is temporarily closed. Aww.	Museum other " Gallery " cafe Gallery other " " "

	17.52 OK, we're looking for a place to have coffee.	"
	18.35 A: We can't go up	"
	20.27 Whoops. OK. This is a very small room.	Gallery
	Clip 2 0.36 R: No, the other one. I don't know where - it doesn't say anything on the map? What it's about?	other
	6.33 R: Mm.... Room 2. OK.	Gallery
	7.51 A: This way or what?	
	9.02 OK, we're moving into room... 3!	"
	10.21 Umm...Now I'm moving across the hall...	"
	12.12 OK, room 5	"
	16.01 R: OK. We're moving... to... um... room 6.	"
	16.59 OK we just kinda walked through that room...so I'm now in room 7.	"
	18.52 OK. Moving on. Room... Ooh, colourful room... 8.	"
	20.10 We're in another room.	"
	20.58 Is this a new room? I think we're gonna come back to that room. It's a bit confusing. OK. I'm in room 10 now	"
	24.58 Room 12.	"
	26.22 OK. Well we've done part of floor 3 and part of floor 4. And of course floor 6, which is very important. Ready to wander back to Waterloo? Ok we're going down the escalator	other
	Clip 3 1.42 OK we're trying to get out of the shop	shop
3.5 Design of exhibitions, programmes, and		

technology [added by Kevin]		
❑ A. Exhibitions	2.10 R: There's something here, that's in the nature section. We have to go to the nature section. So now what is that called - nature...?	Gallery
	2.55 R: Must be incredibly hard to design something for this space, 'cause you've got so many different ways of –	Turbine Hall
	7.54 We're moving into a room of really famous paintings. It's called Distinguished Voices in fact, the Monument Trust gallery	Gallery
	13.34 Oh a whole Rothko room, cool.	
	Clip 2 2.49 I love these floors. The wood is just fantastically kind of rustic. Nice.	"
	3.12 Oh, I like the way it was before.	other
	3.50 A: I remember the first thing I saw here was, you came up the escalator	Museum
❑ B. Programs		"
❑ C. Technology (related to exhibitions)	4.19 I'm gonna read the thing on the wall.'Cause that always helps me.	
	20.58 It's a bit confusing.	"
	N/A	
	N/A	

Appendix 6

Tabulated student data from trails in Ch. 7

School 1

Group s1

	food plants w people	food plants	people	audio	collected	other	not usable
	3	23	13	3	2	5	3
classroom							
9	boy holding courgette (sideways)						
		veg in box					
		veg on table					
		jar of pickles					
	boys holding veg						
							sound not saved
		veg on table					
	close-up cut veg						
		veg on table					
order beds			group w teacher				
						plant w label	
22							
		pea family					
		lettuce w people					
		Ladybird (important because they were interested in insects)					
				"We are now..."			
		Crambe in the cabbage family					
				"This plant is called..." (cut off)			
		Squirting cucumber (courgette family)					
		bean					
			boy w plant				
		Artichoke					

boy w plant

close-up bud

volunteer w box

volunteer w boys

courgette w flowers

cabbage

cucumber

lettuce

veg bed

black

Group f3

	food plants w people	food plants	people	audio	collected	other	not usable
	6	2	0	1	3	8	1
classroom							<1 sec. sound
7	veg on table girl w bean under nose	carrot box carrot on box					
		parsnip & potato in box					
				Celeriac & the celery smell pretty much, so they go in the same column, the carrot column. [Brilliant]			
order beds					potato plant cabbage cucumber		
3							

Group o1

	food plants w people	food plants	people	audio	text	collected	other	not usable
	0	5	1	2	0	0	3	0
classroom		celeriac						
1								
order beds		lettuce						
10			girl w clipboard					

		lettuce						
				The leaves of the flower look as if they're hard but actually they're soft. [adult] Good.				
		bean plants						
				[adult] French beans disperse by explosion at the end of the summer. The leaves dry up then disperse.				
		bean plant						
							white flower	
							yellow flowers	
							close up plants in bed	

Group t2

	food plants w people	food plants	people	audio	text	collected	other	not usable
	4	15	0	11	0	1	14	3
classroom		root veg						
13		beans on table						
		various veg						
				The peas are with the beans b/c they're the same colour, the same size, and the same shape				
	girl holding bean							
				These are parsnips and carrots and they are [inaudible]				
	girl holding broccoli & cauliflower							
	boy holding potato							
				[inaudible] underground stems are called tubers				
				Cauliflower and broccoli are flower buds b/c [inaudible, cut off]				
		various veg on table						
		tomato, chili						
		cut bean						
order beds		cherry tomato plant						
30		veg bed						
							blue flowers	
		basil						

cabbage
bean
carrot seedlings
scarecrow
The scarecrow is there to scare the birds away so they don't [cut off]
Modus [?] peas come from France
bean
plant
[inaudible] is green, but on the outline [?] it is light green
new sound [?] default picture
new sound [?] default picture
Leaf flowers are divided into 3 and the flower is white.
Once the flower bud is open, the flower gets [inaudible] and the leaf drops off, and it turns into fruit.
hand holding bean leaf
lettuce and chive
Chive belong to the onion family b/c they're leaves are thin and they stick out.
blue flowers
blue flowers closer
white flowers
plants in bed
tall flower
DESCRIBED] Pea plant about to climb a trellis
fennel
plant
fountain
lawn, flower bed
flower bed close
Flowers can be different shapes and sizes

Group t3

	food plants w people	food plants	people	audio	text	collected	other	not usable
	3	0	0	3	0	0	0	1
				[adult] What are you doing there? [inaudible]				
classroom								
	students w							
7	celery							
	boy holding up parsley							
	hand holding parsley							
				This is a leaf because on the back you can see [inaudible]. [adult] Good girl. So you think parsley's a leaf b/c of that? Good thinking [student's name]. Brilliant. [cut off] [adult] All right, do you think [inaudible] b/c... [student] B/c it smells the same. [cut off]				
								too short

Group f2

	food plants w people	food plants	people	audio	text	collected	other	not usable
	2	25	2	3	1	3	9	
classroom		chili						
				I think this should go in the box... because it looks like the picture				
8								
		peppers						
		pepper, aubergine						
		vegetables on table						
		vegetables on table						
		vegetables on table						
					We think basil smells like mint			
order beds		fennel						
		etc						
40							red flower	
							plant from below	
	girl under fennel							
						carrot		
		carrot						
		family						
		sue holding unripe pods (in						

carrot family)

plants in bed
sage
family

mint

carrots on
clipboard

mint

plant

Potatoes don't belong in the carrot family because [next student] potato leaves are bigger than the carrot leaves [first student] and in the carrot family there are [group] celery, parsnips, fennel...[cut off]

potato flower
courgette
courgette
beans

Tell us something about the courgette. [next] They're bigger than your hand [1st] What is? [2nd] The courgette. [1] OK then, thank you v. much. Tell us about the courgette. [Sue] What colour are the flowers BTW? [cut off]

radish
marigold
courgette leaves
carrot on ground
lettuce (unrelated)
beans
pea pod and flower
lettuce (unrelated)
beets

scarecrow

potato

beans
tomato flower (similar to
potato)

sue holding
potato flower

cucumber
cabbage

statue
flowers

pea

teacher at
lunch
student

School 2

Group s3

	food plants w people	food plants	people	audio	text	collected	other	not usable
	10	10	14	4	3	4	5	
							flower bed	
							geese	
		veg on table w papers						
classroom 16			classroom					
					The parts of a plants are stem roots flowers leafs and the seeds			
	Gail olding							
	fennel							
	boys holding cabbage & broccoli							
		veg on table						
		veg across table						
	boy holding aubergine w label							
	teacher holding pepper							
	boy holding cauliflower							
	same boy w cauliflower							
		cut veg						
		cut pepper						
	boy holding cut pepper over box							
	girl holding cut aubergine							
		same-family veg on table						
			boy outside at lunch					
order beds						cucumber		
22			boy at lunch [?]					
			ambulance					
			student at lunch					
			class having lunch					
			boys at lunch					
			goose w students at lunch					

boy
boy sticking out tongue
girl

Emily hendeson here my time at kew gardens has been fab so thank you very much love emily

mint
Mandrake [LABELED]
mint
blurry plants
cucumber
blurry bed

autumn carrot' label close up
carrot
plant
beetroot label close
beet
plant

statue

Group f7 (N.B. This phone was shared between two groups)

	food plants w people	food plants	people	audio	text	collected	other	not usable
	6	14	4	10	7	1	5	0
classroom	hand holding aubergine							
28	hand holding tomatillo							
	hand holding pepper							

The tomartow is a fruit because it has seeds inside.
We took a piture of fruit veg and diffrent parts of a flower
We are seeing wich foods are tomatos

student holding squash
boy holding potato & carrot
tomato box close

We're looking at maize and tomatoes - different colours and different shapes, even cabbages.

cabbage
lettuce

girl w cabbage

potato

We are looking at tomatos

We're looking at some tomatoes w flowers in a different place.

potato

[student 1] Action. [s2] This is [name]. [sings song]. No no no, forget that one.

potatos, beans

deadly nightshade

Here are some tomatoes. Olden days, ladies used to take the juice out of them and put it in their eyes to sparkle. This flower is called the Deadly Nightshade.

mandrake

Action. Here are some Mandrakes. They are in the tomato family. You will recognise them from Harry Potter and the Philosopher's Stone, when he pulls the plant out, and finds a little figure screaming.

We have found some different tomatoes. Mandrakes, Deadly Nightshade, and normal tomatoes. They have different names but they're from the tomato family.

A potato is a type of tomarto and a tomarto is a fruit so that means a potato is also a fruit.

student

cucumber

It is really good here at kew gardens it is interesting you can learn lots

order beds

mint

11

sage

family

mint

family

Right then, so how do you feel - what do the plants smell like that you've just felt? [s2] Like mint. [s1] Any other smells you smelt? [s2] No, not really. [s1] Ok then, thank you v much.

Group o3

	food plants w people	food plants	people	audio	text	collected	other	not usable
	1	8	9	8	0	5	9	0
classroom		beans veg on table veg in box						
3								
order beds						pea plant pea plant w text: 'We are learning about peas'		
23							shrub shrub	
		pea family	girl different girl	Hello we are in the order beds, and this is group 2 again, and we are having such a fun time looking at the peas. Hello this is so cool. This is group [break] the order beds. This is so wicked cool fantastic. [garbled] They look like peas.		pea plant *mandrake		
		*mandrake		We've just seen a mandrake, and they told us a story that if you pull it up, the mandrake screams and kills you of madness.				
		courgette				cucumber		
			boy girl teacher and students at lunch	We are eating our lunch now, and everyone is wanting [garbled] to win the World Cup.				
			World Cup trainers	This is what Ben thought of Kew Gardens. What did you think of it Ben? Did you like it? [Ben] Quite				
			girl					

Group t6

	food plants w people	food plants	people	audio	text	collected	other	not usable
	3	11	9	6	2	6	12	0
classroom		aubergine						
4					Most the carrot family smell the same			
			boy making face					
	boy holding veg (blurry)							
order beds						Fennel		
30	boys w fennel							
		carrot family						
		dug up carrots (rabbits)						
	courgette plant							
		lettuce bed						
				Hello my name is Harry				
				Fennel is bright green, can grow to 2m tall, it has a mint, and its leaves can grow to 4cm long				
							scarecrow	
		parsnip bed						
				Carrots can be orange, purple and white. They are also roots. And they are one of the many vegetables.				
		*fennel seedling						
					Ae			
				This report is about beetroot. Beetroot is purple and round, and is a vegetable. And a root.				
							blue flowers	
						mint		
		mint family						
				My project on mint. Mint can be useful as flavouring [break] from 10cm to 120cm high. They are mainly planted in pots and in the ground.				
		mint						
						mandrake		
		pomillo (tomato family)						
						Mandrake w/ text: 'Becoz there names give away that their		

poisons'

structure
palm house & pond

girl
boy
at
lunch
2
boys

Pea plant

tree in palm house
palm leaf
walkway in palm house

boy making face

trees in palm house

Group t7

	food plants w people	food plants	people	audio	text	collected	other	not usable
	0	12	6	12	1	3	12	1
classroom		root veg on table veg on table						
7							classroom	
			students	[girl] investigating a plant, and we don't know what it is, so let's go off and find out! [boy] Really now? Now for George with the weather! Thank you very much. Goodbye people!				
		mint family veg in box veg on table						
order beds			boy making v signs					
30			boy					
							flowers Labiatae label	
						mint mint		
				This plant is laminium barginicum... rub my fingers against them. Very strong smell, slightly of vinegar. Reminds me of very very				

strong mint. Lovely.

It [inaudible] very very minty in a way, and very firm when you rub it, with a bit of rough texture.

It smells very minty, and it's very hairy. It's very soft as well.

This leaf smells very minty. It's soft. It's rough when you feel it. It's [cut off]

The organim [inaudible Latin name] It's very minty - sweet! And I think you can use it in cooking [inaudible] And gives me quite a nice taste on my tongue I can't get rid of.

When the bee lands in the flower, it pushes all the pollen forward, and it gets rubbed onto the back, which makes the job easier for the bee to collect all the pollen. Amazing stuff this. Stop.

[Sue] ...into a hive, it isn't just - you know when they buzz? If you do basically what they do when they're buzzing. OK? So it heats up, and it actually melts the pollen, and it becomes wax.

Anyway, if they do come in, it's gonna be a bit [inaudible] like this - break in, and they'll just fix it up again. [s2] A bit weird.

Those flowers - they look like [inaudible].

We've just decided that they look as if they're in the mint family - they probably are in the mint family actually.

...flowers, I think they're very minty and soft [inaudible] It's very soft and furry and things like that, and bumpy.

new sound' w default picture

[Sue] Would anybody like to read the name on there? [student] Mandrake madrigora officinarum [Sue helps finish] it says on there. Anybody heard of Mandrake? [Students say yes]

mint family

nettles (same family)

green tomatoes

leaves

plants nr palm house

students eating lunch

cucumber

students at

lunch

ambulance
students at lunch
leaves

Kew is cool

Group f6

	food plants w people	food plants	people	audio	text	collected	other	not usable
	1	20	0	3	0	7	13	0
classroom		beans on table aubergine on table						
10		veg on table						lemon tree
		leaf veg w label more leaf veg w label beans w 'bud' label						
	hands holding marrow							
		aubergines						
		cut veg in box veg sorted on table						
order beds							flowers flowers flower	
30		courgette radish						
				We have noticed that some flowers have courgettes on the end, and some have not grown into courgettes yet and they're just flowers.				
		courgette flowers tomato sign deadly nightshade label mandrake label						
						mandrake		

potato

On the cabbage, the butterfly has laid caterpillar eggs and eaten through it, and left them there, so there are little tiny black greeny eggs laying on the cabbage.

*cabbage with holes

spinach w sign

blue flowers

flowers

flowers

flowers

pretty leaves

yellow flowers

We found 4 varieties of the same flower with 4 petals, [inaudible], and the same one over here, and then here, and then here but they're a bit more yellowy [cut off]

white flowers

flower 'iberis amara'

pea

mint

cucumber

cucumber

palm house

goose

mandrake

cucumber

School 3

Group o2

	food plants w people	food plants	people	audio	text	collected	other	not usable
	1	13	0	8	2	0	1	1
classroom		root veg on table						
3		Seseli montana sign						
		fennel						
order beds							scarecrow	
13		fennel						
		carrot family						
		parsley						
		courgette						
				Today, well [] actually, we've been looking around the student garden, and studying the carrot family, and things like that. And we found out a couple of things, like the courgette [cut off]				
				Today we have been finding out things about the fruit and veg in the carrot family				
				Right, today was BRILLIANT. It was the most exciting thing [s2] Yeah! [s1] and very INTERESTING [s2] We learnt about plants [s1] yes, very interesting plants [cut off]				
				Today was the most brilliant thing I've ever been to. [s2] Wow! [s1] We learnt about vegetables and plants. It was BRILLIANT, WOW! [screams in bkgd] That was my two friends.				
				Today was brilliant. We learnt loads and saw loads, and it was fun. Thank you.				
				I learnt lots about the [] family of carrots, and I saw lots of different vegetables, and it was really fun. [s2] Save that				
				[misc. yelling]				
								black

Group t4

	food plants w people	food plants	people	audio	text	collected	other	not usable
	0	11	0	0	3	3	8	0
classroom		veg on table						
1								
order beds								structure in garden
						mint w/ text: 'For info'		
19		Savlia fruiticosa						
					Mint info			
		Labiatae sign I think it's in the mint family						
					Ah info			
		Lemon thyme w sign						
		A parsley seedling?						
						mint		
		Spinach young						
		Spinach older						
						mint		
							statue	
							statue	
							flowers	
							fountain	
							flowers	
					Kew is a fun place to go			

Group t5

	food plants w people	food plants	people	audio	text	collected	other	not usable
	1	10	0	9	0	3	7	0
order beds		courgette						
	hand holding							
25	courgette							
				The leaves are big, and the courgette is grown with flowers on the ends. [s2] And the flowers are yellow, and they are growing quite quick. And they've got - the leaves [cut off]				

cucumber

carrots

The courgett leaves are two hands wide.

deadly nightshade

The deadly nightshade is very poisonous [s2] and it's the same relation as a tomato plant.

mandrake

mandrake

poppies

doing the lettuce family, and we've just found some small white flowers that they have gi-normous leaves. They're like rhubarb [s2] and they have crinkles in them.

hand holding sm white flower

We have just been looking at the cabbage family, and we have noticed that all have four petals. They're different colours, but the way to recognise them is simply the four petals.

hand holding sm 4-petal flowers

hand holding flower

pea plant

The tendril of the peas wrap around the sticks to help them grow.

courgette

tomato plants?

The tomato plant twists around the sticks to help them grow and [garbled]

there ia a bit of dock in there but not sure what they were trying to capture

carrot

sign

carrot sign w plants

In the United Kingdom we do not find much cucumbers because we haven't got the right temperature, and it's not in the right season. So we put them in greenhouses to make them grow.

big tree

Group f5

	food plants w people	food plants	people	audio	text	collected	other	not usable
	2	14	1	5	2	4	3	1
classroom								black
6		celeriac on table student holding pepper fennel on table grouped veg on table grouped leafy veg on table						
order beds						carrot w text: 'Because the leaves look the same'		
20			group					
				How heavy was the largest carrot grown and where was it grown? [other student] It was 8.5 kg and it was grown in Alaska				
		umbelliferae sign order bed w scarecrow fennel						
						fennel		
		courgette						
						cucumber		
		courgette						
						cucumber		
		umbelliferae bed long shot umbelliferae sign umbelliferae bed long shot						
							cactus greenouse?	
				We've just sat down for lunch. We've just came back from the student gardens We've just learnt about the carrot family and what veg. And fruit are in it.				
				Today was brilliant. We had lots of things to do. [student 2] We were concentrating on the carrot family, and learnt lots of things about the carrot family. [s1] And saw lots of it. [both] It was brilliant. What's the heaviest carrot and where did it come from? [s2] The heaviest carrot is 8.5 kg and it comes from Alaska. [s2] Good - that is the correct answer - brilliant, love.				
							fountain	

plant in palm house

Group s2

	food plants w people	food plants	people	audio	text	collected	other	not usable
	3	16	1	8	0	2	14	0
classroom	2	veg on table						
	6	kids w veg on table						
		holding aubergine on table						
		pepper						
		leafy veg						
		grouped veg on table						
order beds							trellis near order beds	
	26						order beds	
							? Plant	
						pea plant w text: 'To record research'		
		potato flower						
		bean						
						pea plant		
		Tomato						
				It's got the hairs on the pods so that if an animal or insect tries to take a bite out of them, the hairs lodge in its throat and [garbled by passing plane]				
				They're different colours so when the birds come up they'll think they're leaves not peas so they won't eat them. [someone else] camoflaged.				
				[adult] these are bumblebees that we've got				
							flowers	
				The petal's full up [Sue] And the petal's full up - that's unfortunate. Yes there are peas there - if you put it up against the light you can see the peas. [child] yeah [sue] OK. Yes do, smell it! That's the only thing you can't record on here I'm afraid. You have to actually get one [cut off]				
							? Plant	
		order bed w scarecrow and kids						
							scarecrow	

pea including flower
beans
thermometer

Why do they put CDs near the peas? [other child] To scare off [break] probably see the bright lights and they won't go near there because they'll think they're blinded. But they're not but they're just dazzled, because they reflect light.

pea
plant
pea
plant
herbaceous border

Go. Peas are waterproof and the drops sit on [cut off]
* Pea leaves are waterproof because the water sits on top of the leaf.

order
beds

Group f4

	food plants w people	food plants	people	audio	text	collected	other	not usable
	1	11	1	1	0	1	1	0
order beds	students at veg bed							
8		tomatoes						
		tomatoes						
		tomato						
						mandrake		
		Deadly nightshade						
			girl w clipboard & mobile					
		courgette						

School 4

Group o

	food plants w people	food plants	people	audio	text	collected	other	not usable
	2	5	2	4	0	2	1	0
classroom	boy w marrow							
2	boy w parsnip							
				[s1] Now! [s2] OK, we're working on the Herculum candicans now, and we figured out that the textures are different. It's spiky round the edges, and stems - ones are quite hairy, and the other ones a bit smooth.				
order beds								
		carrot						
10		sign						
						carrot		
		carrots						
		carrot						
		carrot leaves						
						fennel		
			group					
						cabbage w text: 'Because carrot relative'		
				[garbled] ...it kind of has green leaves on it, they're kind of a bit spiky, and it smells a bit [cut off]				

Group t

	food plants w people	food plants	people	audio	text	collected	other	not usable
	0	8	0	3	0	0	2	1
classroom								overexposed
		cut						
3		celeriac						
				[adult] OK, explain what is in your box. [student] These are herbs that might go into the basil family because they all have leaves and they all smell nice. [adult] Which ones are they? [s] They're [cut off]				
				This [garbled] is called [garbled] and the stem is well not triangular but square, and hairy.				
order beds								
		mint						
11		family						
				This is [garbled] got a bit of hairy on it.				
						mint w text: Because it is in our		

family

beetroot
beetroot w sign
red
lettuce
courgette
veg bed
carrot

?
Plant
?
Plant

Group f1

	food plants w people	food plants	people	audio	text	collected	other	not usable
	4	8	0	9	5	1	2	0

classroom

girl w courgette

Why do you think that is a courgette? [s2] I think it is a courgette b/c it is long and green. [adult] OK

9

girl w marrow
girl w cut courgette and marrow
girl w cut courgette and marrow

The squash and marrow both fit in with the courgette

cut
squash
jar of pickles

We looked at lots of things

order beds

courgette
flower

[Why does it] have a flower on it? [s2] I don't know.
We're gonna describe the courgette plant. It has a yellow flower. It's got spiky leaves round the edges which are green [s2] and big [s3] and the stems [cut off]
How many courgettes do you think will grow on this plant? [s2] About 7, because there are 7 buds on the stems.

15

cucumber
* We wanted to collect the cubumber because we are learning about the courgette family.

courgette
family

The leaves' edges of the Icbalium electrium are spiky, but the actual leaf is a bit vast, but it's quite [cut off]

?
Plant

bean

The leaves are green, smooth but a tiny bit bumpy, and the size is smaller than [garbled] Why do you think the sticks are standing up above the [break] [s2] Because the leaves might grow bigger, and to keep the leaves together.

courgette family

These are the similarities that we've found of the courgette and the cucumber family. [s2] The leaves are rough [s3] Some of them had vines [s4] And they usually have heart shaped leaves [Canadian mum] There. We'll leave it at that for now.

Group s

	food plants w people	food plants	people	audio	text	collected	other	not usable
	0	9	0	10	0	5	7	0
classroom				The carrot and the parsnip are the same. They all grow underground, and they're root vegetables.				
8				We're trying to do the [break] the marrow, because they're the same shape and the same texture, same colour.				
				We connected all the herbs together [garbled] because they all grow above the ground, and they're all herbs and leaves.				
				We chose the fennel, cabbage, red cabbage, broccoli and cauliflower. The texture of the cauliflower and the broccoli on the top are the same, and the leaves of the red cabbage and the cabbage [cut off]				
				We tried to put the tomatoes and the aubergines together into our box, because they're all a fruit, and they all have seeds				
		pepper, aubergine and tomato with box						
				The beans all have little pods inside that have [break] So they're all the same. And the texture's all the same. And they hang down off the plant.				
		marrow and courgette						
order beds		cabbage family						

15

This is spinach. It has big [break] along the ground and then up. They are very thick. It has very small white flowers with yellow centers.
The plant has leaves that are very small. And there are little flowers placed randomly along the stem. The stem is 8 to 10 cm long.
This is our description of [garbled]. The stems are quite long, some are diagonal, the leaves are quite small and bent. The flowers are pink and purple.

?
Plant

spinach w sign

?
Plant
?
Plant

carrot
carrot
carrot w text: Flowers are in clusters
mandrake
mandrake w text: Surprised its posinous part of tom family

deadly nightshade
pomillo (tomato family)

Appendix 7

Tabulated data from Chapter 7

Table 1. Objects captured/collected at each location, by school group

	Classroom	Order beds	Total
School 1 group S1	9	22	31
School 1 group F3	7	3	10
School 1 group O1	1	10	11
School 1 group T2	13	30	43
School 1 group T3	7	0	7
School 1 group F2	8	40	48
School 2 group S3	16	22	38
School 2 group F7*	28	11	39
School 2 group O3	3	28	31
School 2 group T6	4	30	34
School 2 group T7	7	30	37
School 2 group F6	10	30	40
School 3 group O2	3	13	16
School 3 group T4	1	19	20
School 3 group T5	0	25	25
School 3 group F5	6	20	26
School 3 group S2	6	26	32
School 3 group F4	0	8	8
School 4 group O2	10	5	15
School 4 group T 3	11	0	11
School 4 group F1	9	15	24
School 4 group S 8	15	8	23

Total	151	418	579
Max	16	40	48
Min	0	0	7
Avg	6.23	18.75	32.91

* Phone shared between two groups

Table 2. Type of data captured/collected, by school group

Group	Photos of food plants with people	Photos of food plants	Photos of people	Audio	Text	Other	Not usable	Total
S1	3	23	13	3	0	5	3	50
F3	6	2	0	1	0	8	1	18
O1	0	5	1	2	0	3	0	11
T2	4	15	0	11	0	14	3	47
T3	3	0	0	3	0	0	1	7
F2	2	25	2	3	1	9	0	42
S3	10	10	14	4	3	5	0	46
F7*	6	14	4	10	7	5	0	45
O3	1	8	9	8	0	9	0	35
T6	3	11	9	6	2	12	0	43
T7	0	12	6	12	1	12	1	44
F6	1	20	0	3	0	13	0	37
O2	1	13	0	8	2	1	1	26
T4	0	11	0	0	3	8	0	22
T5	1	10	0	9	0	7	0	27
F5	2	14	1	5	2	3	1	28
S2	3	16	1	8	0	14	0	42
F4	1	11	1	1	0	1	0	15
O	2	5	2	4	0	1	0	14
T	0	8	0	3	0	2	1	14

F1	4	8	0	9	5	2	0	28
S	0	9	0	10	0	7	0	26
Total	53	260	64	123	26	141	12	679
Max	10	25	14	12	7	14	3	—
Min	0	0	0	0	0	0	0	—
Avg	2.41	12.5	3.5	6.14	1.5	7.05	0.68	

Appendix 8

Student trails from Chapter 7

NB: Due to the large size of this data it is made available to download separately:

http://www.lkl.ac.uk/people/kevin/phd/Appendix08_kewtrails.pdf (22.8 MB)

Appendix 9

Audio and video transcripts from Chapter 7

NB: Due to the large size of this data it is made available to download separately:

http://www.lkl.ac.uk/people/kevin/phd/Appendix09_transcripts.doc (216 KB)

Appendix 10

Plant Science Gardens module information from Chapter 7

Overview: Pupils will visit the Botanic Garden to use the garden's wide range of plants/vegetables. Botanic Gardens are centres for classification. Pupils build on the work completed in school from previous units of this module. **Aims:** To recognise that Botanic Gardens hold and conduct research into a diversity of plants Pupils recognise that plants can be grouped into families according to their different characteristics, in particular using variations in flower fruit leaf, or stem characteristics **Objectives** That pupils recognise and can name the parts of a plant That children can 'sort' according to characteristics That children become familiar with the concept of 'fruits' (seed holders) and how this relates to 'vegetables' **Teaching sequence:** **Morning** 1. Brief explanation of the Botanic Garden and its role 2. Recap using a real plant to illustrate the 'parts of a plant' and 'what is a fruit and what is a vegetable'. 3. Whole class to discuss how they might identify a plant. 4. In groups, pupils to sort vegetables into families (by observing colour, skin, texture, smell, shape, leaves) into the named boxes e.g. to sort those vegetables that they think belong to the 'carrot family'. 5. Pupils to walk with their boxes to 'Order Beds' at a Botanic Garden or to vegetable plot with appropriate signage that identifies plant families. Each group will look for plants in the family they have worked on first and then move on to observe at least one other family. 6. In pairs pupils write in their sciencist's notebooks the similarities and differences observed (3 pairs per pupils per order bed) 7. Pupils observe the characteristics and discuss their vegetable families 8. Groups are asked to move to plants in another family and repeat 7. 9. On a post-it note each pupil writes one or more things that they	**Time** 2 hours am 2 hours pm **Material** 6 labelled boxes one for each plant family A range of vegetables from the carrot, cabbage, tomato, cucumber, bean and mint families Rulers, magnifiers, knives Post-it notes Activity sheet 5 Set of cards with 10 vegetables / fruits (from a tropical glass house) **Skills** **Observing,** **developing verbal** **reasoning** **Keywords** botanic garden , diversity, conservation, classification, research, comparison, sepal, petal, stamens, stigma, nodes, roots, bud, stem leaves, flower **Cross-curricular Activity**

have discovered this morning. 10. Display post-it notes on a wall chart. (You may wish to categorise the "discoveries") Lunch (could include a discussion about how many plants are in lunch boxes and/or recycling opportunity (compost and other + brief discussion) *Afternoon* 1. Brief tour of tropical glass house to explore the broad diversity of fruits and their families 2. In groups from morning session pupils to 'explore' one edible plant that the teacher has allocated them. 4. In their groups pupils to create a poem / drama / mime or similar to describe/ explain the use of their selected plant without mentioning its name. 5. The groups to reconvene and perform their pieces. At the end of each performance the rest of class guess the plant and explain how they knew what it was.. 7. Class recap on skills needed to identify a plant 8. Pupils write in science notebook 3 key learning points from the day and make a wish - **3 stars and a wish**	Literacy – scientific language Geography Drama
Teachers' Notes: Pupils will be looking at vegetables/fruits from specific families and can observe the diversity of plants in these families They will be looking for evidence to support their initial classification. **Before the visit** **Helpers on the day** should be given a programme prior to visit and if possible attended lesson on parts of a plant **Pupils will need to bring:** Scientist's **notebook** and pencil for each child A **plastic bag** (or similar) to sit on in wet weather conditions or where grass may be damp. Adequate **water** to drink Equipment and lunch in **a rucksack** or similar for easy carrying Please pre 'sort' the children into 6 groups	

Student checklist for observing plants

Stems	**Fruit**
• Is the stem ridged or smooth? • Is the stem round or square? • Is the stem hairy or not? • What colour is the stem? • Is the stem 'woody' or green and soft? • Does the stem have leaves on it?	• What shape is the fruit? • What colour is it? • What size is it? (length & width) • Can you still see sepals at the base of the fruit? • Does the fruit have a scent? • Does the fruit remind you of anything you eat?
Leaves	**Flowers**
• What shape is the leaf? • What size is the leaf (length)? • What does the tip look like? • What does the edge/margin look like? (e.g. is it wavy, spiny, and smooth?) • What does the base of the flat part of the leaf (blade) look like? • Is there a stem to the leaf? • How are the leaves attached to the main plant stem – in pairs or individually? Opposite each other? Alternate? Spiral? • ·Is the leaf hairy? If yes- on one side? On both sides? • Is the leaf the same on both sides? (colour, hairiness, texture) • Are the leaves at the bottom of the plant stem, or arranged all along it? • Does the leaf have a strong smell?	• How many sepals to the flower? • What colour are they • Are they joined up • How many petals? • What colour are the petals? • Are they joined up in a tube? • Are there markings on the petals? • Are all the petals the same size and shape? • Do the petals and sepals line up with each other, or are they alternate? • How many stamens are there? • Do the stamens lie in the same line as the petals or not? • Do the stamens have a stalk? • Do the stamens hang out of the flower, or are they 'inside'? • How do the stamens open to let their pollen out? • What colour is the top bit of the stamen where the pollen is? • What colour is the pollen? • What does the part in the middle look like? (round, oval, bumpy etc) • Does the flower have a scent? • How are the flowers grouped? (all squashed together, one individual flower at the end of one stalk, in an umbrella shaped 'dome')

Appendix 11

Student paper data from Chapter 8

NB: Due to the large size of this data it is made available to download separately:

http://www.lkl.ac.uk/people/kevin/phd/Appendix11_foundingpaper.pdf (14.6 MB)

Appendix 12

Audio transcripts from Chapter 8

NB: Due to the large size of this data it is made available to download separately:

http://www.lkl.ac.uk/people/kevin/phd/Appendix12_transcripts.doc (228 KB)

Appendix 13

Transcript of audio trail constructed in Chapter 8

1: Corams Children gallery

KW:
Start by going into Coram's Children on the ground floor.

Coram's Children gallery

S1:
My name is Mrs. Copperbottom and I am one important woman. I am the governess of the Foundling Hospital. I am from the high class, and in my opinion of London, hmm. Well London is a very dirty place. No one has any standards. The poorer people get drunk [breaking glass] and those dogs will be howling around everywhere [dog sounds].

If you walk to your right of the room you will see a picture of Gin Lane [horse sounds]. Hogarth's interpretation is exactly correct [pig sounds]. Imagine just lying there in the street [coughing], seeing and smelling dead people. Eww, how disgusting [baby crying]. Loads of children are abandoned and not looked after by their neglectful parents. How sad.

If you walk around the wall behind you, you will see what our hospital looked like [birds singing]. Don't you think it's a grand building? Well I must say it is myself. I've been the governess of this hospital for an extremely long time, and I know they're trying to get rid of me - I've heard the rumours myself.

As a governess I would have to accept the babies that came into our hospital. We have a very strict guideline that needs following. They are: Only the first babies of a married woman could be accepted; the child must be under 12 months old; the mother should have a good character previous to her misfortune; there must be evidence that the father could not be found.

At times it felt unfair to allow some babies and not others. You mustn't say a word but I do generally have a soft spot for those peasants. But I can't say anything, so I just play mean

[sound of children playing]

You can see that the girls and boys would not have any contact whatsoever - well we wouldn't want any more little foundlings, would we?

Oh, and there's a chapel where all the grand singing would take place [sound of choir]. We better be moving on now.

KW:
Now walk through the door and into the Committee Room.

2: Committee Room

KW: Committee Room

S1:
One busy day, I, Mrs. Copperbottom, was reading important documents, on precisely May the 13th, when I was disrupted by a woman with a baby, and a police guard. They told me it was an emergency, so I decided to deal with it there and then.

[sound of children playing]

What are you doing in here? You're supposed to be in the courtroom.

[sound of baby crying]

S2: Yes ma'am. My name's Margaret Lanier, and I need you to take my child.

S1: And how do you think I could help you?

S2: You can give it everything that he needs. My husband's gone now.

S1: And where's your husband gone?

S2: He's dead.

S1: He's dead? How did your husband die?

S2: He was drunk and abusive, and I was protecting my child, and my unborn child.

S1: So you killed your husband.

S2: Yes, but it was an accident, it was out of character.

S1: Do you think your child is gonna turn out like you in the future?

S2: No, I'm a loving person, I'm a kind person. It was out of character.

S1: Okay and um, when was the last time your child had food?

S2: Um, last week. The prison wasn't feeding me -

S1: Last week!

S2: The prison isn't feeding me well -

S1: We can't accept an unhealthy baby.

S2: It's not unhealthy, it's healthy. It just needs some food.

S1: And, um, you've mentioned your other child - you do realise we only accept the first child.

S2: Yes, but it's my first daughter.

S1: Don't try and play smart with me!

S2: Yeah but I need you to take my child - I'm desperate!

S1: I'm sorry to say that we won't be able to accept your baby.

S2: Miss, please take my child! I don't understand -

S1: We will not be able to accept your baby. Can you take her away please!

[sound of door slamming]

KW: Next, go up the stairs to the first floor. Turn right, and right again, into the courtroom.

3: Courtroom

KW: Courtroom

[sound of baby crying]

S1: Next please! Um, can you shush that baby and take a seat.

S3: Yes ma'am, thanks ma'am.

S1: And um, what brings you here?

S3:
I'm Eliza Jefferson, and I work with Mistress and Master Smith, and I've been away with my child. And I'm soon to return to my master, and my mother is very unwell to take care of my child, and I need you to take care of my child for me.

S1: And, how do you think I can help your child?

S3: You can take my child by taking her in, and giving her shelter and protection.

S1: Um, you mentioned you had a job - what was that?

S3: Um, I was a servant at Mr. and Mrs. Smith's apartment.

S1: Okay. And why can't you look after your child?

S3: Um, I was forced into this pregnancy by Ben, and he -

S1: Who's Ben? Was you married to Ben?

S3: He promised to marry me before the birth of this child, but he's gone now, he ran away.

S1: And have you searched high and low for Ben?

S3:
I've searched everywhere for Ben. My master and mistress helped me search for him, but we could not find him.

S1: So you're positive that you cannot find Ben.

S3: Yes, madame.

S1: Okay.

S3:
This baby is very happy and handsome and makes very little noise, and it wouldn't really be a burden onto you.

S1: Are you sure about this?

S3: Yes ma'am, I'm positively sure.

S1: And can you tell me a little about yourself? Your character?

S3:
I'm a very honest, kind, hardworking, well not educated, kind of polite young lady. And you can ask my mistress, Mrs. Smith about me.

S1:
Okay. Well hearing your story I've come to the conclusion that your child may be accepted into our Foundling Hospital.

S3: Thanks madame.

S1: Um, say your goodbyes and quickly go to the woman there.

S3: [sobbing]

[sound of baby crying]

S1: Okay yes, hurry up now. Next!

KW: As you come out of the courtroom, go straight ahead, then turn left into the large picture gallery

4: Picture Gallery

KW: Picture gallery.

[gentle orchestral music]

S3:
Taking my little baby to the Foundling Hospital brought a lot of different emotions to me. I was very excited when the governess said my baby was accepted, and had been given a space at the hospital. This was because I still had my job and I could still be a respectable woman.

I was asked to leave a token to my baby for easy access to reclaim her. I left a black and white beaded bracelet in the token box. It was the only thing my grandma gave to me before she passed away. My grandma was the best. I grew up with her my my mother worked to make our lives better. She said the bracelet would bring me luck in whatever I do. I promised to cherish it. It's so special to me. I'm not sure if this token will be handed over to my baby, and if she would have any information about me.

My heart was torn apart, but at the same time I hoped her life would be better than mine. Seeing a picture of Thomas Coram, looking kinda nice with his big red coat, reassured me that my baby was in good hands.

I hope that one day I can come and reclaim my baby, but I have to move on with my life, and be a respectable woman. Giving her my lucky bracelet was to show that I love her, and I acknowledge and respect the fact that she is a part of me.

KW: From the Picture Gallery, go through the door and next to the painting of Thomas Coram.

5: Anteroom

KW: Anteroom.

S2:
I was one of the many foundlings in this hospital. Like all of the other children I do not remember my mother, and have nothing of hers. When I was 12 years old, I overheard the matron and the secretary talking about the beautiful token my mother had left me. It has never been given to me.

[sounds of dining room]

I remember on Sundays when we ate, wealthy visitors use to come around and watch us. Even though I knew in my heart I wished one of them was my mother, and would take me away, I always felt she never wanted me until I was older, and I realised she could not provide for me as well as the hospital could.

Thinking of these things made me very emotional, and in this strict hospital, it is hard to express yourself. Singing was part of me releasing my feelings. Every Sunday I used to sing in the church choir [sound of choir]. These are some of my best memories from the Foundling Hospital.

KW: Next, go up the stairs to the second floor.

6: Handel Room

KW: Second floor.

[Handel music plays in background]

S2:
Dear Georg Friedrich Handel,

You are the best musician of our time. The other foundlings and I always look up to you and we wish we could sing over your music one day. You are a very important man to the hospital and I still do not know quite why, but your name is always mentioned at Sunday concerts. I always look forward to Sundays because we see all the rich people dressed in their finest clothes and we get all excited. I admire you and your music. I want to be a composer just like you one day, but I fear I will just be an ordinary servant. Please write back,

Amy Bentley.

S1:
My good friend Handel is an absolutely fabulous musician. He helped fund our hospital by making awesome concerts. He is an inspiration to a lot of our children. He was actually an orphan, and was in a similar situation to some of the foundlings at the hospital.

He actually composed the Foundling Hospital's anthem. He is simply too great and will never be forgotten.

Mrs. Copperbottom,
Governess of the Foundling Hospital

[music fades]

KW:
This audio tour was written and performed by [S3], [S1], and [S2], with thanks to CitiZEN and MLA London. All characters are loosely based on the stories of the Foundling Hospital.